TECHNOLOGY DEPARTMENT

Power Generation

and POWER PLANT ENGINEERING

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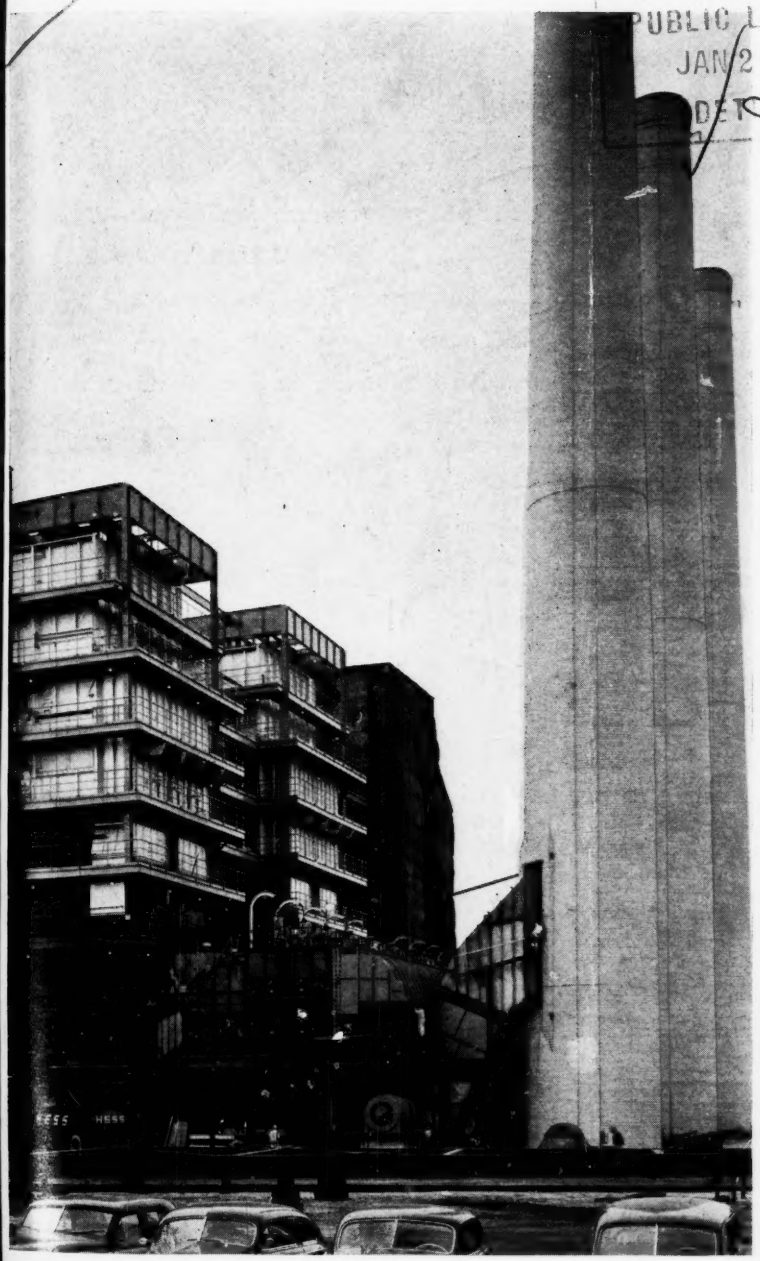


Engineers' Preview 7
Helpful Bulletins 35
New Equipment News 42
Power Generation, Present and Future 53
- Electric Power Development in the U. S. in 1948 54
- Coal Still Heads the Energy Parade 57
- Developments of 1948 in Power Stations and Equipment 58
- Electrical Engineering Advances 64
- Gas Turbine Developments in 1948 68
- Atomic Energy 68

Solvent Cleaning and Boiler Design 69
By E. R. Kilsby
Engineering Opportunities, Reheat, Gas Turbines, Control-Featured at 69th Annual ASME Meeting 74
18th National Power Show 76
Atomics 78
- Don't Worry About The Uranium Supply
By Andrew W. Kramer
- First Graphite Put into Place at Brookhaven Atomic Pile

Soft Water Hardened at Oakdale Plant of Newport Industries 81
Correction Note:—Where Will Ultrasonics Fit in the Power Field 81
THE PRACTICAL ENGINEER
Old Dutch Pumping Stations 82
By H. Wieland Los
Reducing Waste in the Use of Low-Pressure Steam for Heating 85
By H. B. McDermid
Practical Hints and Kinks 86
- Sharp Tools Save Labor
- Speed Nut Fastener Simplifies Electrical Connections

Letters and Comments 87
Questions and Answers 90
- What is Best Length for Adjustable Piston Valves on Uniflow Engine?
- Why Did Nipple Cause Safety Valve to Blow Incorrectly?
- How Calculate Condenser Spring Support?
- Why Design B. F. Pumps for Safety Valve Flow?
- Who Knows About Incentive Bonus Systems for Ammonia Refrigeration Plant?

Temperature Conversion Tables 92

• • •

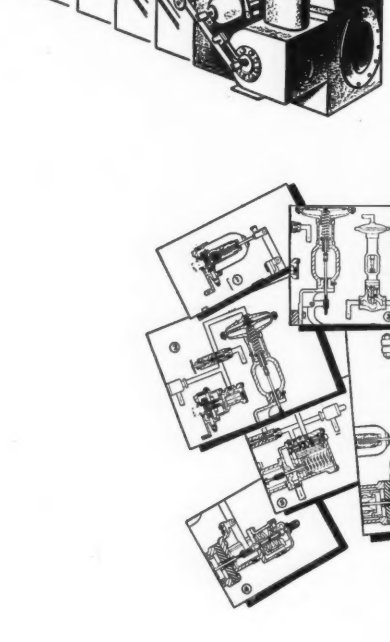
Details of New F&E Spreader Stoker 94
New Stocking-out Conveyor for Cahokia 94
New Bankside Power Station 96
Coming Events 112
Obituaries 112
News from the Field 124
New Engineering Books 125
Construction News 128

COVER: View of Sewaren Generating Station, Public Service Electric and Gas Co. (N. J.) showing outdoor steam generating units (third unit under construction). Two 100,000-kw turbine generators, the first at 1050 F, are now in service.

For Power Engineers Responsible for Supply of Steam, Electricity and All Other Power Plant Services

Every way, it *clicks* w

'R v.53' Jan.-June 1949



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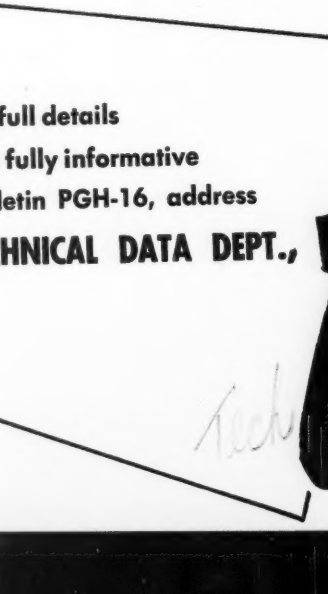

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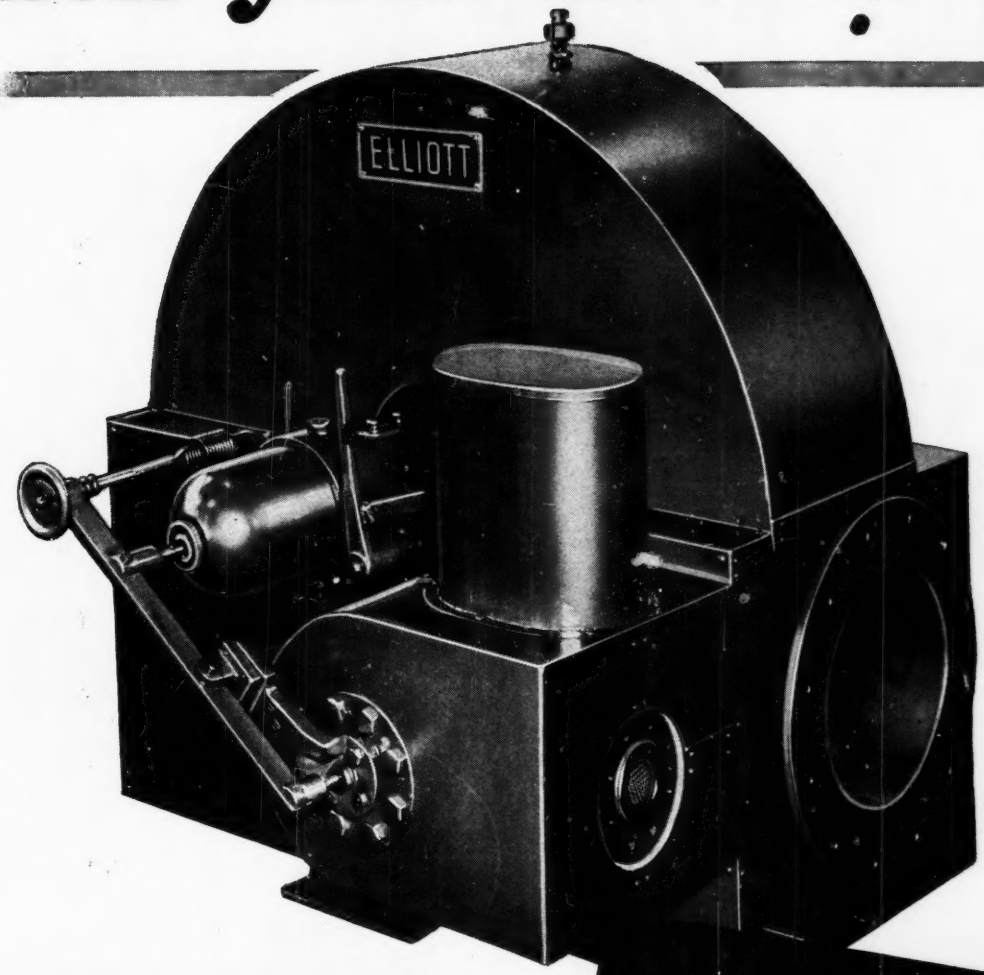

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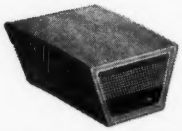

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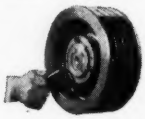

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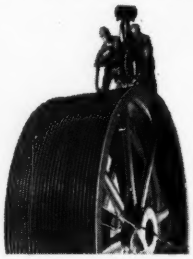

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Published Monthly by
TECHNICAL PUBLISHING CO.
53 W. JACKSON BLVD.
CHICAGO 4, ILL.

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Subscription Information—Published Monthly. Prices: United States and Possessions one year $10.00, Canada one year $11.00. Other countries one year $12.00. Single copies $1.00. Changes of address should give both old and new address and reach us by 15th of month to be effective with following month's issues. The Annual Index is furnished as a part of the December issue.

Power Generation

January, 1949

VOLUME 53—NUMBER 1

Engineers' Preview 7
Helpful Bulletins 35
New Equipment News 42
Power Generation, Present and Future 53
Electric Power Development in the U. S. in 1948 54
Coal Still Heads the Energy Parade 57
Developments of 1948 in Power Stations and Equipment 58
Electrical Engineering Advances 64
Gas Turbine Developments in 1948 68
Atomic Energy 68
Solvent Cleaning and Boiler Design-I *By E. R. Kilsby* 69
Engineering Opportunities, Reheat, Gas Turbines, Control-Featured at 69th Annual ASME Meeting 74
18th National Power Show, Grand Central Palace, New York 76
Atomics 78
Don't Worry About The Uranium Supply *By Andrew W. Kramer*
First Graphite Put into Place at Brookhaven Atomic Pile
Soft Water Hardened at Oakdale Plant of Newport Industries 81
Correction Note:—Where Will Ultrasonics Fit in the Power Field .. 81

THE PRACTICAL ENGINEER
Old Dutch Pumping Stations *By H. Wieland Los* 82
Reducing waste in the use of low-pressure steam for heating 85
By H. B. McDermid
Practical Hints and Kinks 86
Sharp Tools Save Labor; Make Jobs Easier
Speed Nut Fastener Simplifies Electrical Connections
Letters and Comments 87
Does it Pay to Take an Interest in One's Work?
What do you Mean by Thermal Efficiency?
Note on the Speed of Light
Superheat Spoof
Questions and Answers 90
What is Best Length for Adjustable Piston Valves on Uniflow Engine?
Why Did Nipple Cause Safety Valve to Blow Incorrectly?
How Calculate Condenser Spring Support?
Why Design B. F. Pumps for Safety Valve Blow?
Who Knows About Incentive Bonus Systems for Ammonia Refrigeration Plant?
Chart of Temperature Conversion Tables 92
Details of New F&E Spreader Stoker 94
New Stocking-out Conveyor for Cahokia 94
New Bankside Power Station 96
Coming Events 112
Obituaries 112
News from the Field 124
New Engineering Books 125
Construction News 128

Contents of back issues of Power Plant Engineering and Power Generation will be found in both the Industrial Arts Index and the Engineering Index on file in Public Libraries.

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Entered as second class matter February 10, 1948 (original entry May 1, 1908), at the Post Office, Chicago, Illinois, under act of March 3, 1879.

STORES KNOW

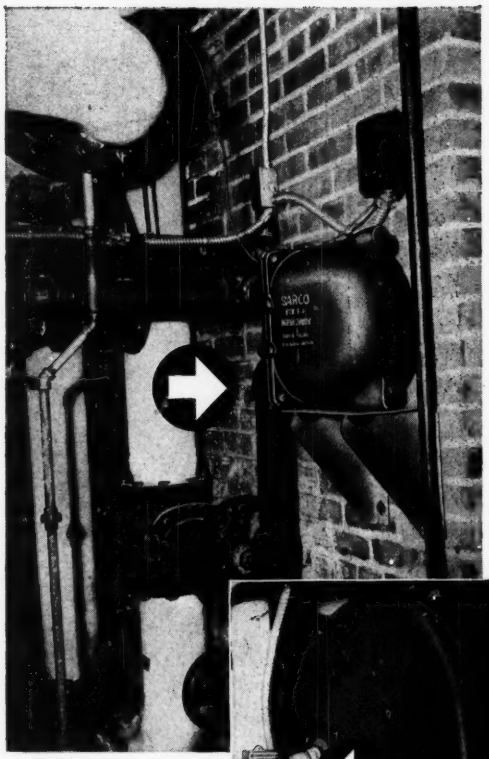
How to Buy Heat!

Stores employ expert buyers and astute salesmen. They know the value of comfortable heat and the necessity for keeping costs down. And they are big buyers of Sarco Steam Traps and Temperature Controls for heating and hot water service.

This large Cleveland Store illustrates the point. Sarco Float Thermostatic Traps insure continuity of service from the main hot water converter. For each store section, a separate recirculating tank is motor controlled with a Sarco Immersion Thermostat. Sarco Radiator Traps and valves are standard on each floor. And a nearby department store is still saving 10% of the fuel with better heating from a system that was made All-Sarco several years ago.

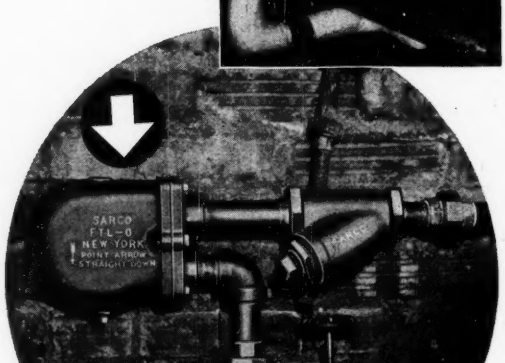
Restaurants also have to please customers and keep costs down. A special Sarco hook-up to provide the right temperatures for dish washing and another temperature for service water, is used extensively wherever hot water is used.

You are paying for these Sarco advantages in higher fuel costs. Why not get Sarco and let it pay for itself? Our nearest representative will show you how.



FT Trap on Converter

Circulating Pump Control



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ENGINEERS' PREVIEW

MOUSE MILK is now $10,000 a quart. Yeah—prices sure are high everywhere. But 3000 black and white mice at Columbia University Medical School are good for only two quarts of milk a year, reports *The Power Specialist*, and it costs $20,000 to obtain this two-quart output. Who wants two quarts of mouse milk, you ask? Well, they use all the milk in cancer research; and, certainly, if it helps gain knowledge in that field, it's worth every cent.

★ ★ ★

ONLY ONE major mechanical "bug" remains to vex the experts who built the world's biggest telescope atop Mt. Palomar. According to *Scientific American*, the 200-in. mirror's supporting mechanism refuses to behave properly. Without near perfect functioning of the supporting gear, the 29,000-lb mirror warps out of shape due to its own weight when tilted through its various working angles. Friction in the present gear, although amounting to only 1.3 per cent of the weight supported, causes the complex system of balancing weights and lever mechanisms to lag behind the motion of the mirror and hence to impair the optical performance of the instrument.

If the big disk were to be supported simply by its edges the center of the mirror would sag as much as half a thousandth of an inch, 500 times the allowable limit! To hold the glass within the five millionths of an inch demanded by its designers, it rests on a cushion comprised of 36 counterbalancing units, each consisting of more than 1,100 finely wrought parts. One of these assemblies fits into each of 36 indentations which collectively form the cellular back of the mirror.

So ingeniously were the supports designed that theoretically the mirror would retain its shape even if it were paper thin. New supports, designed to replace the present ones, are now under construction.

The final adjustment of the huge instrument represents a mechanical problem of upmost delicacy. The optical essence of the two-million pound telescope amounts to less than a quarter of an ounce! Its 200-in. aluminum mirror is but 1/200,000 in thick. All the rest (save the silver-bearing emulsion on the photographic plate); the big disc, the metal frame, the giant ball bearings, are merely support for the thin paraboloid of aluminum.

Three decades ago it took a year and a half to adjust the 100-in telescope; another eight and a half to bring the lag of its supporting system within limits. Relatively, the work at Mt. Palomar is making astonishing progress.

★ ★ ★

GROWN-UPS playing with bubbles may eventually produce cheaper gasoline and synthetic rubber, better plastics and old Bourbon, according to Jerry King of the New York *World-Telegram*. Reporting the recent AICE meeting in New York, he commented on the discussion of bubbles in industrial processes led by Dr. R. L. Geddes of Stone and Webster Engineering Corporation. All modern distillation hinges on sending gas up through a liquid in fractionating towers of refineries and distilleries. These are nothing but ultra-fancy bubble blowers. Latest method of studying them is by use of models of the towers and high-speed cameras to photograph the bubble actions.

BRAIN TEASER: Answer to the question about the inverted check in the October issue is: The check was drawn for $14.32. In paying it the bank teller paid $32.14 by mistake to the man presenting the check. The man, after spending $3.50, found he had left just twice what the check called for or $28.64.

★ ★ ★

REMEMBER that famous wartime sign observed in every store window in New York City during the war: "Illumination is required to be extinguished before these premises are closed to business." That was known as gobble-dy-gook. Much fun was poked at it, for much government and business gobble-dy-gook was being promulgated at the time. Of course, for many years it has been an occupational disease of politicians. But it is not dead. Just consider this example from a recent issue of a local newspaper.

> Reputable person of means, capable of passing rigid inquiry of discriminating rental management, is invited to investigate private offer of responsible executive to sublet desirable W'lton five-room apartment.
> As evidence f good faith, reliable independent Chicago appraiser's sworn detailed report will represent basis for sale at ONE-HALF appraised replacement value of entire high-grade furnishings which present occupant obliged to liquidate. This offer will withstand discerning investigation.

English Translation: High-priced apartment for rent —renter must buy furniture.

★ ★ ★

CLOSING DATE for the Annual Engineering Undergraduate Award and Scholarship Program for 1948 conducted by The James F. Lincoln Arc Welding Foundation, Cleveland, Ohio will be April 1, 1949. Detailed statements of the rules and conditions of this program are given in a bulletin that may be obtained from the foundation by anyone interested. The object and purpose of the foundation is to encourage and stimulate scientific interest in, and scientific study, research and education in respect of, the development of the arc welding industry through advance in the knowledge of the design and practical application of the arc welding process.

★ ★ ★

MORE CARNATIONS—or another bronze plaque, whichever is most appropriate—to Don Allshouse of Northern Equipment Co. for his lecture on boiler feedwater control, which he has presented before many engineering groups recently. It is an outstanding example of good technical speaking, resulting from: 1) intimate knowledge of the subject; 2) enthusiasm for the subject; 3) authoritative, forceful and pleasing platform personality and a voice that can really be heard. Mr. Allshouse is not one of those mumblers-into-a-manuscript against whom we have so often inveighed. On the contrary he speaks as one having authority. He brings out first the factors in the development of the steam generating unit that have led to the development of the various types of feedwater controls, shows how these controls work—but, wait! It's not fair for us to deliver his talk for him when he does it so much better himself. Just go and hear him when his talk is scheduled for your local engineering group. You'll be well repaid.

COMPLETE LINE of heavy duty air-cooled engines for use in U. S. Army truck, tanks and other military vehicles has been developed by Continental Motors Corp. The engines range in size from 125 to 1040 hp. They may be offered later in modified form for commercial use, initially in bus operation and subsequently in trucks, and possibly three to five years from now in passenger cars. The new 250-hp air-cooled engine weighs only 777 lb compared with 2400 lb for a liquid-cooled engine of the same power, including its radiator, water pump, and fan. The air-cooled engine can be mounted vertically in a little more space than the liquid-cooled engine requires for radiator and fan alone. The new air-cooled motors are built either in horizontally opposed or V-type models.

★ ★ ★

READERS interested in the program for development of synthetic gasoline and synthetic liquid fuels in this country will remember the article in *Power Plant Engineering* describing in some detail the power plant services proposed for a synthetic gasoline manufacturing plant to be erected by Stanolind Oil and Gas Company at Tulsa, Oklahoma. (Power Plant Services for Synthetic Gasoline Manufacture, by Roberts and Phinney; *Power Plant Engineering*, August, 1947). Announcement has now been made that this entire project has been cancelled, even though some of the equipment for it, we understand, had actually been delivered to the site. High construction costs were blamed for this decision.

★ ★ ★

SFERICS began in the land where a big wind means trouble. Sferics is the name of a new science that involves tracing storms, and particularly hurricanes, by means of the radio static associated with them. The name comes from a trimmed-down version of "atmospherics." Sferics began as a scientific project at the Florida Engineering and Industrial Experiment Station in 1934 under Dean Joseph Weil of the University of Florida and Dr. Gleason W. Kendrick then at Tufts College, Massachusetts. It gradually developed the present methods used, which involve directional radio antennas receiving signals that are amplified and displayed on a cathode-ray oscilloscope. It has been found that these methods could pin-point the actual source of static in hurricanes with great accuracy. The Army found it could use the science in determining bombing conditions and best routes. Research in the science is now moving faster than ever before at Florida and a post-war Caribbean Sferics Net is now in continuous operation with stations located in Bermuda, Jamaica, Antigua, and Gainesville, Georgia (for research only). Details of the new science are reported in a recent brochure, The Pay-Off in Research, published by the Engineering College Research Council of the ASEE.

★ ★ ★

TRAINING of Americans to work in the Arabian oil fields of Arabian-American Oil Company at a special training school set up for that purpose on Long Island, was announced a short time ago. Reconverting of 26 former Air Force buildings was begun at the Suffolk County Airport. After six weeks' instruction in the Arabic language, history, customs and living conditions, the trainees were to be flown to Saudi Arabia to work. The airport was planned to be used in the company's overseas flying operations if CAA approved.

CYLINDRICAL solid scroll-saw blade built with fluted teeth all around it, so it will saw when being pushed in any direction, was observed recently in a supply shop. Home workshop hounds will welcome this idea; everybody who has ever used scroll-saws and hack-saws knows too well the bad language, inaccurate cutting and spoiled work resulting when you are not careful to guide the conventional saw blade on the cutting stroke in line with the centerline of the teeth.

★ ★ ★

PLANS for the construction of a washing unit to eliminate fluorine gas present in smoke emitted from the Monsanto Chemical Co. phosphorus plant at Monsanto, Tennessee, were revealed recently. Contract for construction of the unit's scrubbing towers has been signed with the Rust Engineering Co. of Pittsburgh, Pa. Contracts for pipe work, erection of structural steel, and electrical work are currently being negotiated. Structural steel storage bin has been purchased from the Nooter Boiler Works.

Actual construction will begin as soon as possible, installation will require approximately one year, cost of the unit, including research and development, will amount to about $750,000. In the scrubbing process, gases from the sintering plant will be scrubbed with a liquid spray, which absorbs fluorine. Another process will then neutralize the fluorine in the resulting liquid.

★ ★ ★

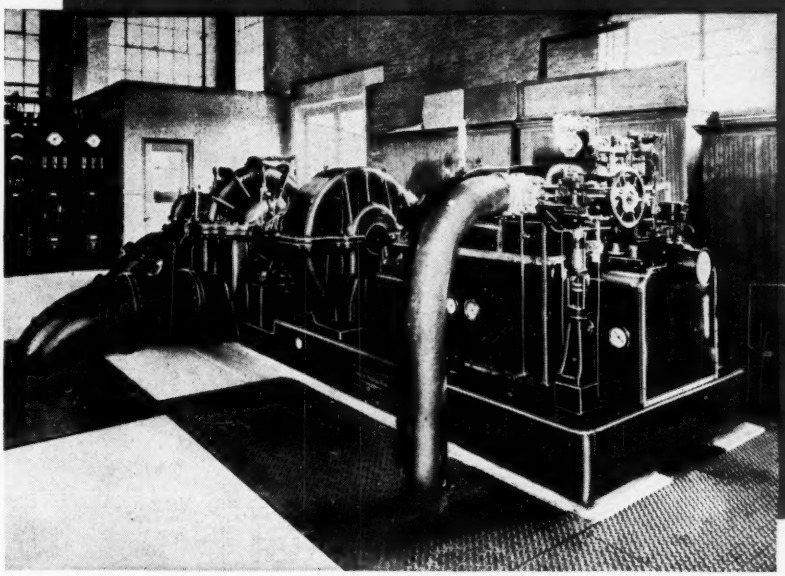
"ALL THINGS considered, the stock market seems to be a barometer of nothing but the confusion of a group of jittery professional traders. Our advice to business is to go ahead with legitimate plans, not without due caution, but without regard to the short-run changes in stock prices." So writes W. Lewis Bassie, Director of the Bureau of Economic and Business Research, University of Illinois, in the *Illinois Business Review*. Professor Bassie points out that for more than two years the market has "dawdled along" in a narrow range, far out of line with business earnings and prospects.

Well, how about electric power production as a business barometer? We note it is one of the selected business indicators used in the *Survey of Current Business* issued by the U. S. Department of Commerce.

★ ★ ★

FOR A NUMBER OF YEARS, the National Bureau of Standards has been engaged in a general research program concerning the influence of temperature on the mechanical properties of metals and alloys. One phase of the program deals with the mechanical properties of austenitic 18:8 chromium-nickel steels at low temperatures ranging down to —188 C, or about —308 F. Such information not only adds to fundamental knowledge of these materials but is also useful in predicting their behavior when subjected to the severe conditions encountered in high-altitude flying, arctic regions, and specialized refrigeration applications. Heretofore, information on the low temperature properties of these steels has been meager; past investigations having been confined mainly to studies at room and higher temperatures. In fact, the literature reveals very little, if any, data on the flow, fracture, and ductility characteristics of these materials at low temperatures. Full details of the work already done and that in progress may be obtained from the Bureau.

FULL PROTECTION



for bearings and governors

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Texaco Regal Oils (*R & O*) free themselves rapidly of air and water, do not develop sludge. Thus, oil lines stay clear and bearing temperatures are kept normal by an uninterrupted flow of oil. Governor action remains instantly responsive. And, even under severest conditions, you'll get extra long oil service life.

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Let a Texaco Lubrication Engineer help you operate turbines and other power plant machinery more efficiently and economically. Just call the nearest of the more than 2300 Texaco Wholesale Distributing Plants in the 48 States, or write The Texas Company, 135 East 42nd Street, New York 17, N. Y.

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TEXACO Regal Oils (R&O)

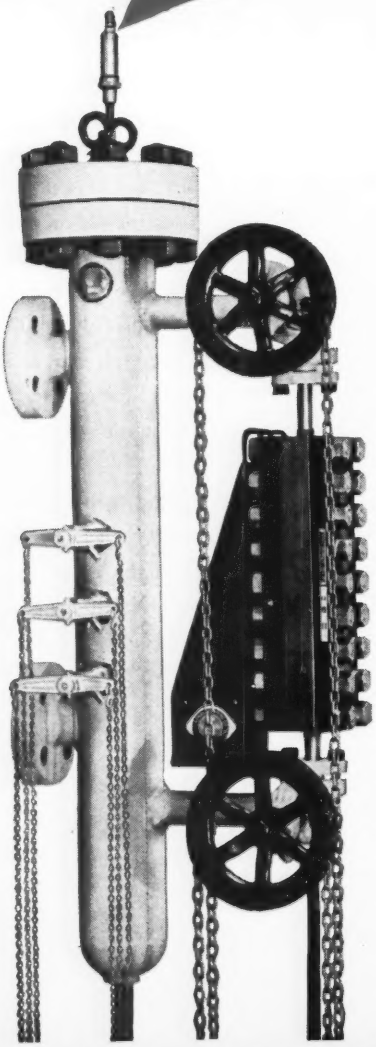
FOR ALL TURBINES

Tune in...TEXACO STAR THEATRE presents MILTON BERLE every Wednesday night. METROPOLITAN OPERA broadcasts every Saturday afternoon.

One

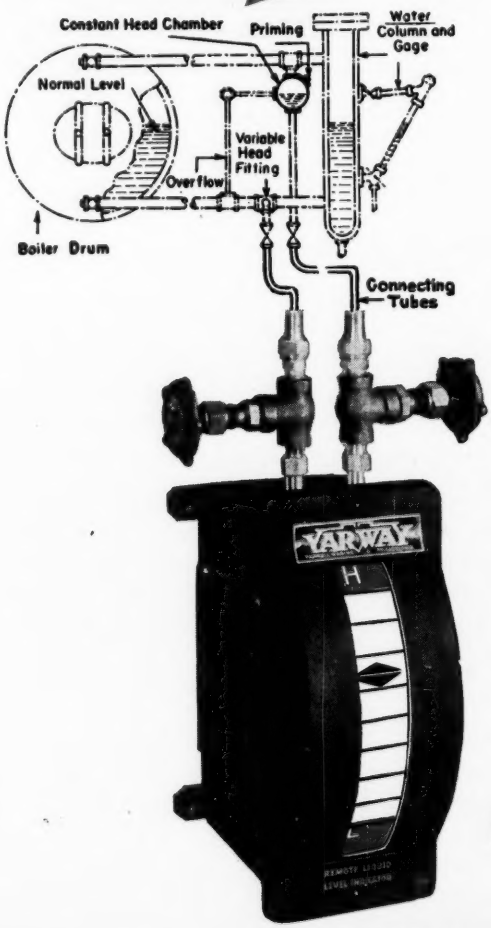
WHEN YOU BUY

YARWAY
WATER COLUMNS
AND GAGES



A

YARWAY
REMOTE BOILER
WATER LEVEL
INDICATORS



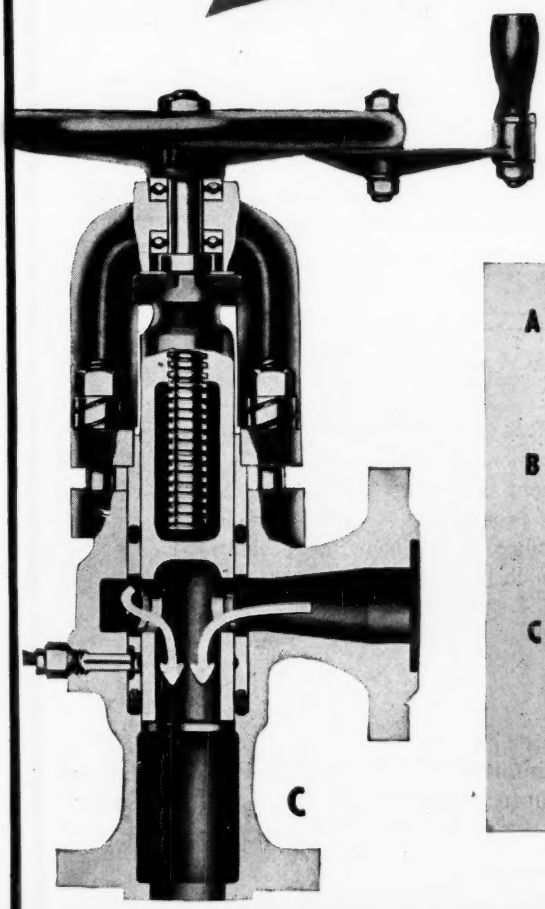
B

YARWAY

RESPONSIBILITY

all 3 FROM YARWAY

YARWAY BLOW-OFF VALVES



Power plant engineers may simplify responsibility by insisting that all three of these important boiler trim items be Yarway.

Why, you ask?

First, responsibility for the satisfactory performance of all three is centered in one company.

Second, Yarway's extensive service organization, with branches in principal cities in the United States and Canada, is conveniently at your service.

Third, each product has an outstanding feature—an *engineering reason,* laboratory-tested and field-proved for better performance.

For more complete facts on these and other products in the Yarway line of steam plant equipment, write for Yarway's all-products Catalog G-1306.

YARNALL-WARING COMPANY
114 Mermaid Ave., Philadelphia 18, Pa.

A — Yarway Hi-Lo Alarm *Floatless* Water Column with patented Yarway Flat Glass Gage featuring a "floating assembly" that practically eliminates glass breakage. For pressures from 400 to 2500 psi. Other Yarway Columns and Gages for lower pressures. Write for Yarway Bulletin WG-1811

B — Yarway Remote Boiler Water Level Indicator that brings overhead readings right down to eye level, on instrument panel or other convenient place. Always accurate because it's operated by the boiler water itself. Action is instant, constant. *No stuffing boxes.* Moderate in price. Easy to install. For all pressures to 1500 psi. Write for Yarway Bulletin WG-1822

C — Yarway Seatless Blow-Off Valve. No seat to score, wear and clog with mud, scale and dirt. Balanced sliding nitralloy plunger simplifies operation. Also furnished in Tandem, or as a Unit Tandem combined with a Yarway Hard-Seat Valve for highest pressures. Write for Yarway Bulletin B-424 for pressures to 400 psi; Bulletin B-432 for pressures to 2500 psi.

STEAM PLANT EQUIPMENT

Equipment by

for CONTROL SYSTEMS

Hagan pioneered in the field of automatic combustion control systems for both stationary and marine boilers—and still leads. Engineering of these and other control systems is one of Hagan's major activities, but the components of these systems are suitable for many other applications, and may be purchased separately.

for FLOW MEASUREMENT

The Hagan Ring Balance Flow Meter is a rugged and accurate instrument, adapted for a wide range of static and differential pressures. Calibration is the same for dry or wet service; range changing is exceptionally easy. Suitable for water, steam, air, gas, oil, and other fluids. *No stuffing boxes.* Calibration by dead weight method checks or takes the place of water column methods. Photos show a few typical models of this meter.

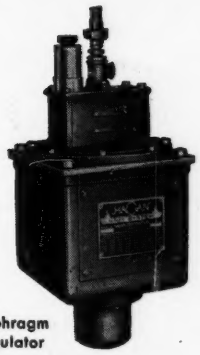
for FORCE MEASUREMENT and other purposes

As designers of control systems, Hagan engineers have on many occasions encountered problems which required the development of special equipment. Some of this equipment has proved to have a wider field than the original application, and has been made commercially available. Several such units are shown here.

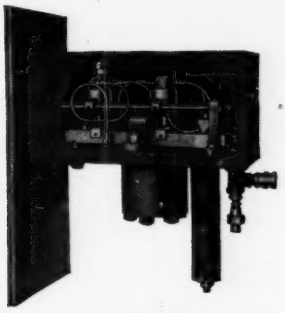
• • •

For full information on any of this equipment and its application to your specific problems, write to Hagan Corporation, Hagan Building, Pittsburgh 30, Pa.

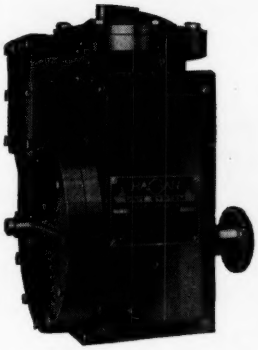
HAGAN



Diaphragm Regulator

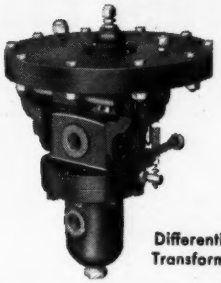


Type "F" Master Sender

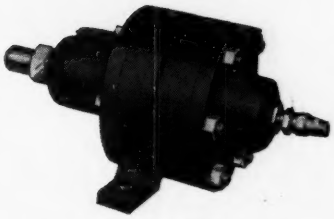


Variable Ratio Regulator

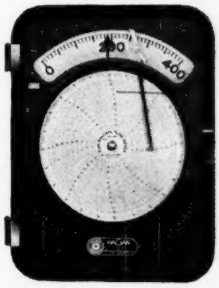
Receiving Regulator



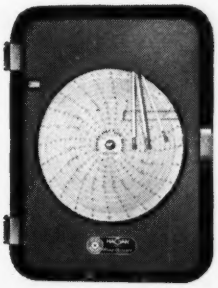
Differential Transformer



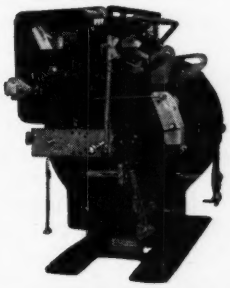
Type "F" Totalizer



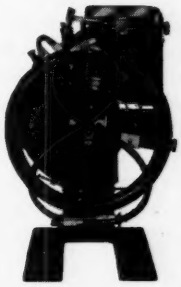
Ring Balance Flow Meter (Indicating, Integrating & Recording)



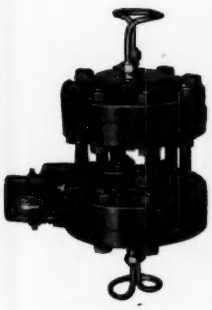
Ring Balance Flow Meter (Integrating & Recording)



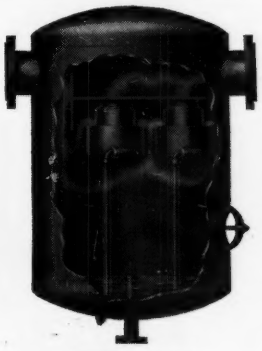
Dual Meter with Integrator (Case Removed)



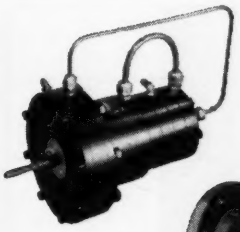
Single Ring Meter without Integrator (Rear View)



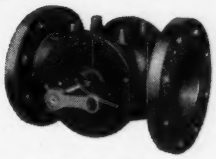
Hagan ThrusTorq



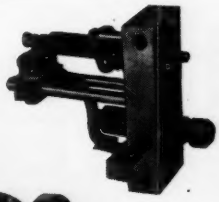
Steam Separator



MicroServo



V Port Butterfly Valve



MicroTrans

Thermostat

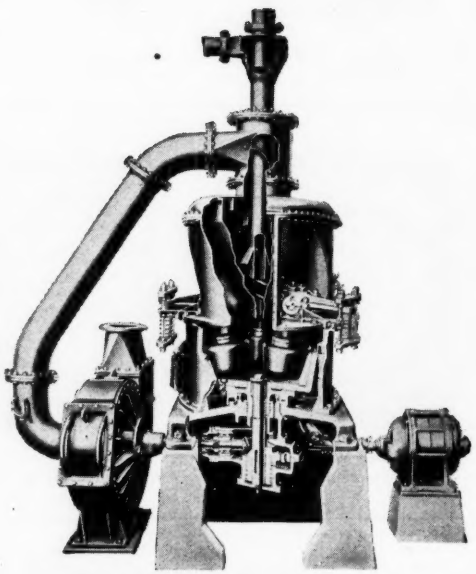
HAGAN CORPORATION

BOILER COMBUSTION CONTROL SYSTEMS
RING BALANCE FLOW AND PRESSURE INSTRUMENTS
METALLURGICAL FURNACE CONTROL SYSTEMS
THRUSTORQ FORCE MEASURING DEVICES

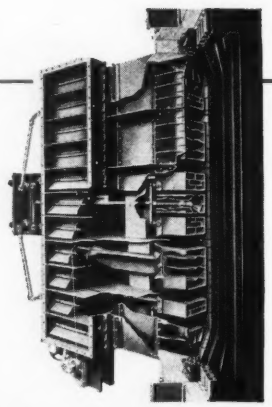
Headquarters for fuel burning equipment

With today's fuel prices what they are, it is more important than ever that your fuel burning equipment be best suited to the fuel most economical for and available to your plant. How then, can you be assured that your particular requirements will be met *exactly?* An obvious step in the right direction is to consult the manufacturer of the world's most complete line of fuel burning equipment — Combustion Engineering.

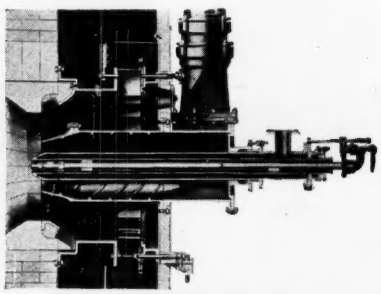
On this page, for example, are the principal components of C-E Pulverized Coal Systems . . . the C-E Raymond Bowl Mill, widely regarded as the best pulverizer on the market . . . the C-E Vertically-adjustable, Tangential Burner for larger pulverized fuel fired units . . . the C-E Horizontal Burner for smaller and intermediate capacities. And on the opposite page is shown the C-E stoker line comprising every type in general use today — a line which reflects the experience gained through installing more than 20,000 stokers of all types . . . a stoker for every coal that is suitable for stoker firing. B-269



C-E Raymond Bowl Mill (Center Feed)



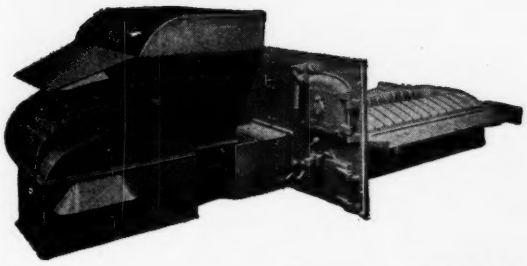
C-E Tangential Burner (Furnace Side)



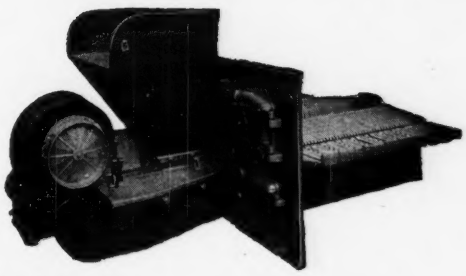
C-E Coal, Oil and Natural Gas Burner

COMBUSTION

C-E PRODUCTS INCLUDE ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS; ALSO SUPERHEATERS, ECONOMIZERS AND AIR HEATERS

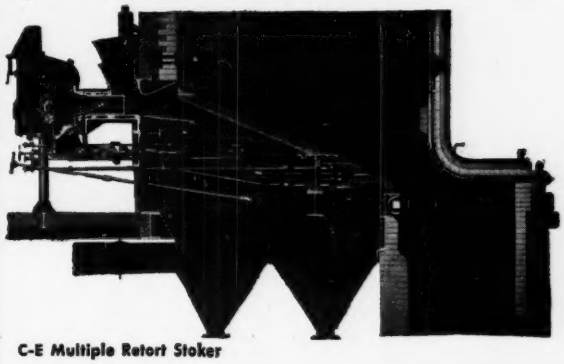


C-E Skelly Stoker

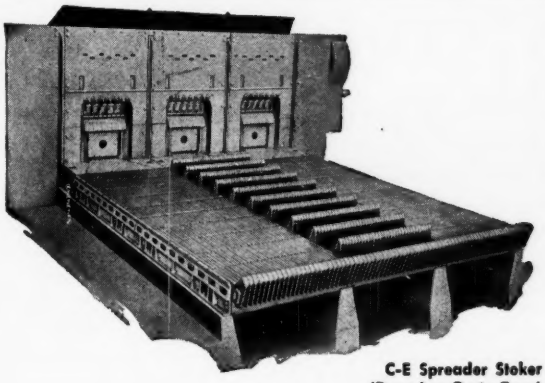


C-E Low Ram Stoker

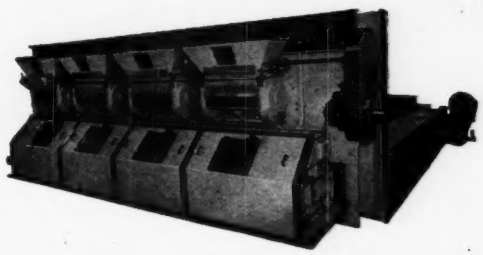
C-E Type E Stoker



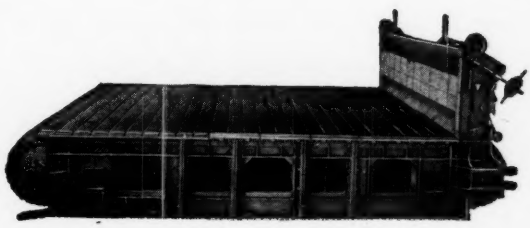
C-E Multiple Retort Stoker



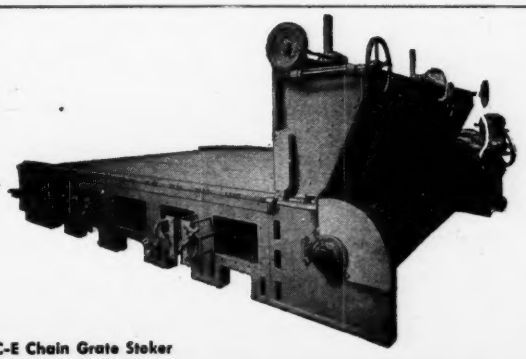
C-E Spreader Stoker
(Dumping Grate Type)



C-E Spreader Stoker
(Continuous Discharge Type)



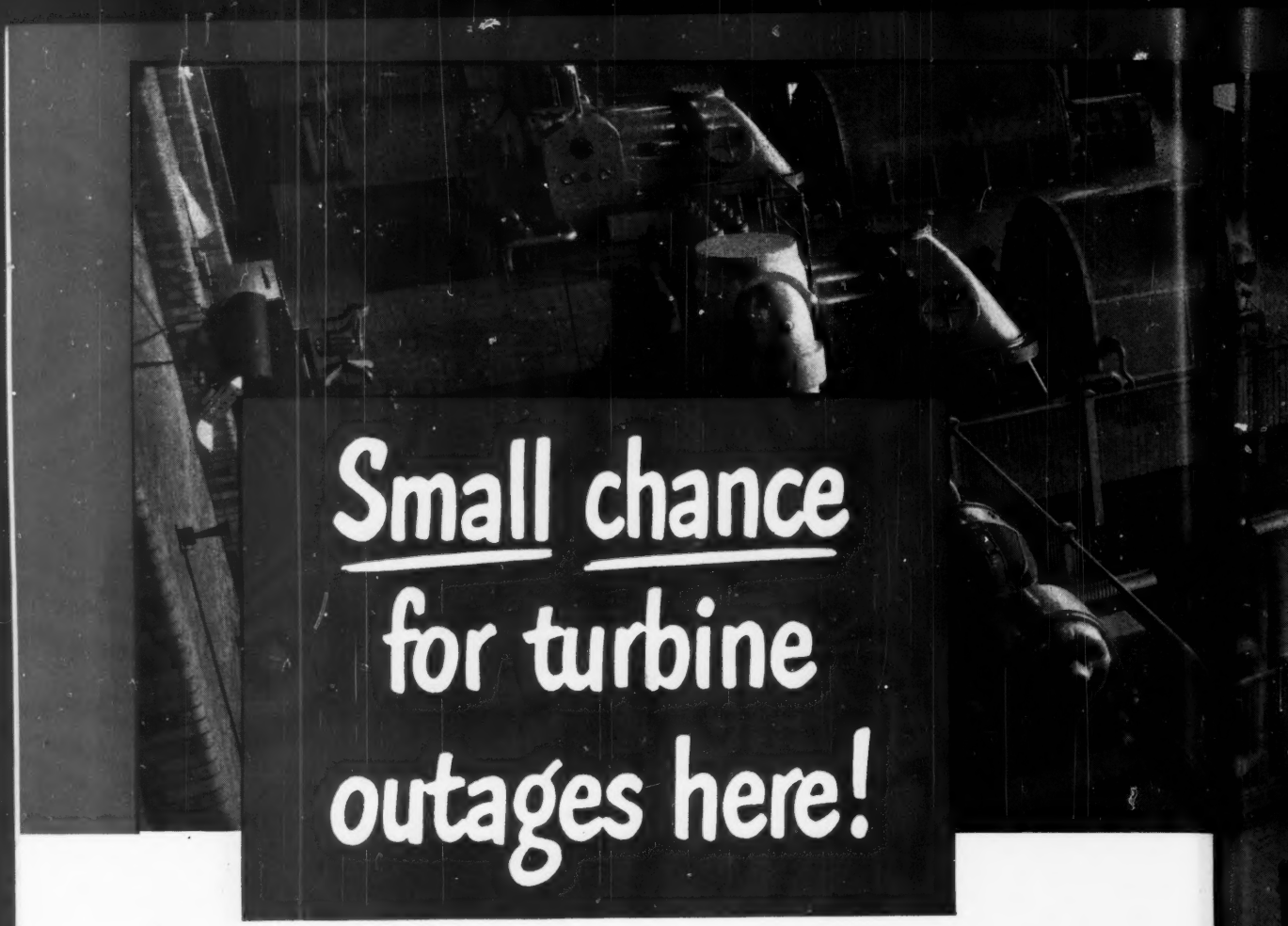
C-E Traveling Grate Stoker



C-E Chain Grate Stoker

N
HEATERS

ENGINEERING
200 MADISON AVENUE, NEW YORK 16, N. Y.



Small chance for turbine outages here!

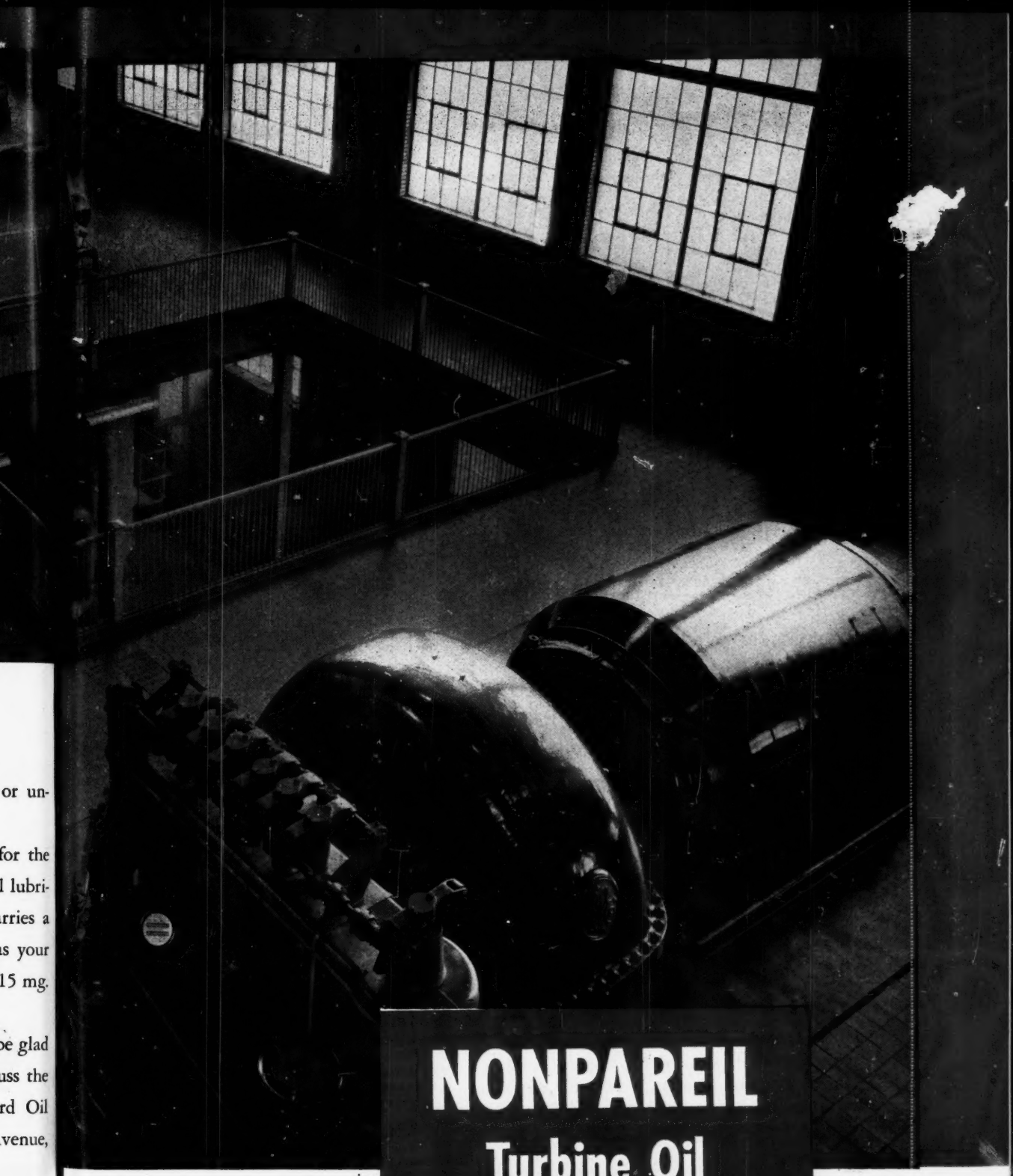
The midwest utility plant, shown in the above photograph, runs little risk of enforced turbine outages because of oil trouble. The 14-year performance record of Nonpareil Turbine Oil at this plant provides the basis for this assurance of safety.

In 1934, Nonpareil was put into one 15,000 KW turbine. A 7,500 KW unit and a second 15,000 KW unit were started on Nonpareil in 1935 and 1941, respectively. The original fills of oil have remained in these turbines for the 7 to 14 years of operation. There has been no deterioration of the lubricant. The oil has not been removed for treating or resting, yet neutralization numbers have stayed below 0.09. There has been no outage time, scheduled or unscheduled, for oil-system maintenance.

Nonpareil assures trouble-free operation for the life of *every* turbine it lubricates. This unusual lubricant is the only product in its field that carries a written guarantee that it will last as long as your turbine without increasing in acidity above 0.15 mg. KOH/gm.

A Standard Oil Lubrication Engineer will be glad to show you this written guarantee and discuss the advantages it holds for you. Write Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois.

STANDARD OIL COMPANY (INDIANA)



NONPAREIL
Turbine Oil

STANDARD OIL COMPANY (INDIANA)

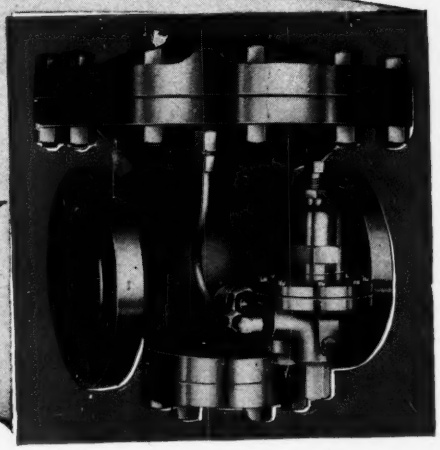
STANDARD

DETROIT PUBLIC LIBRARY

THE FISHER "WORKHORSE" FOR STEAM PRESSURE REDUCTION

BUILT FOR UNFAILING SERVICE

Power engineers everywhere have ok'd the Fisher Type 92 for steam pressure control! It's an accurate, compact, flexible, sturdy controller, designed, built and proved to meet the most exacting requirements for steam service.



TYPE 92

PILOT OPERATED CONTROL VALVE

SINGLE SEATED • TIGHT CLOSURE

The single seated construction assures tight closure and prevents excessive pressure build-up. Reduced pressure ranges 3-200 PSI. Inlet pressure up to 250 PSI at 450°F.

Fisher Bulletin C-2A gives full details. Write for your copy today.

ACCURATE
Pilot control — with its extreme sensitivity to flow changes — maintains the desired reduced pressure with remarkable accuracy. No auxiliary pilot operating medium is needed.

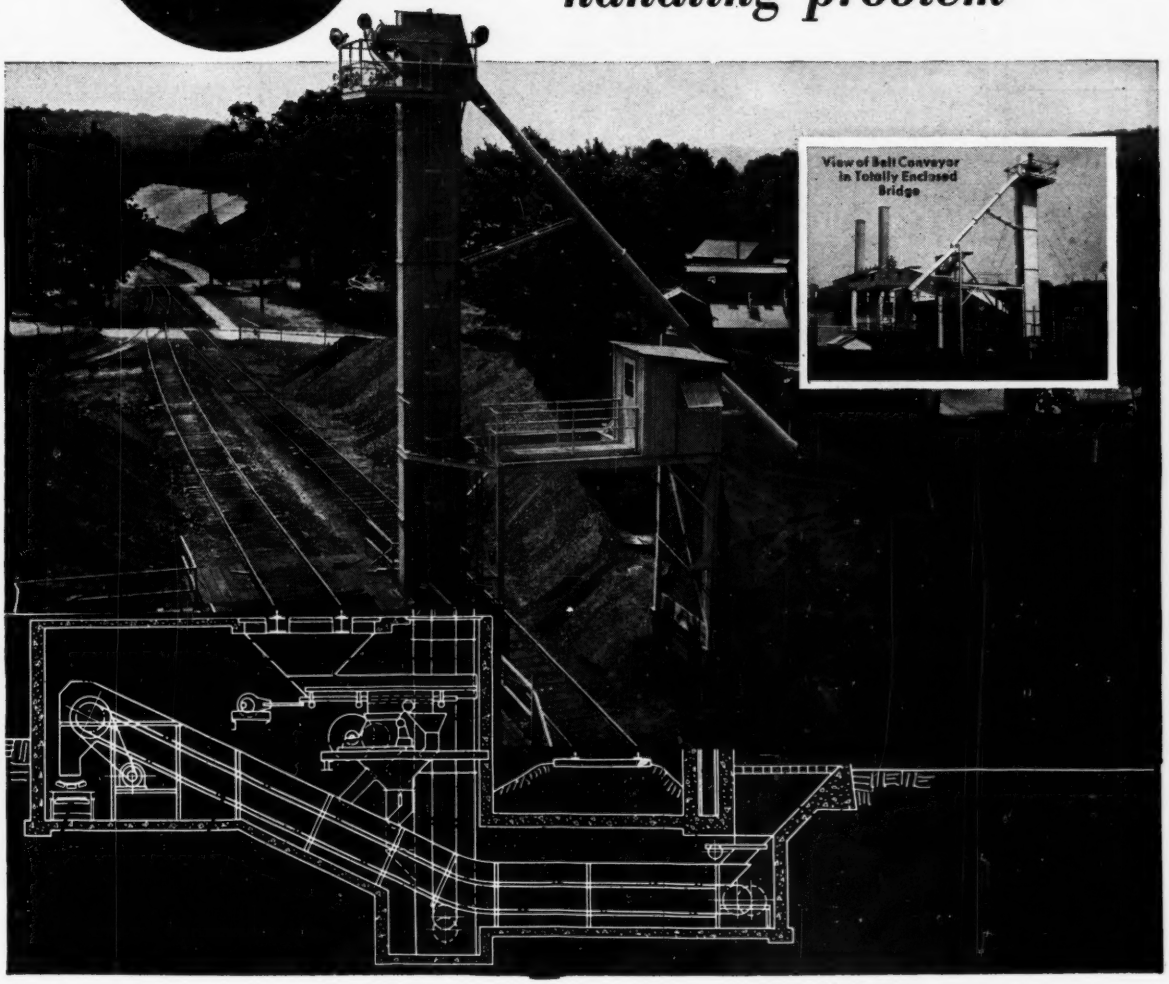
COMPACT
Modern Fisher Engineering has produced in the Type 92 Valve a compact controller with unusually large capacity. Available in 10 sizes from ½" to 2" screwed or 1" to 6" flanged. No special wrenches are required for servicing.

FLEXIBLE
Two pilot assemblies for high or low pressure service are available and interchangeable on all Type 92 sizes. Pilot control spring easily adjusted or changed to obtain a variety of reduced pressure ranges.

STURDY
High-tensile bodies and diaphragm casings are of extremely rugged, ribbed construction. Inner parts are of Duromite bronze or stainless steel—or special material as ordered. Every construction detail designed to assure maximum trouble-free service.

Fisher Governor Company
1648 FISHER BUILDING
Marshalltown, Iowa

went *Underground* to *Overcome* this handling problem



More steam power for peak production at the Picatinny Arsenal, Dover, N. J., called for more coal—more in reserve, more flexible equipment for handling it.

Problem was how best to augment existing facilities to meet this greater demand. A Gifford-Wood engineer looked over the ground—recommended the versatile handling system shown. It provides tremendous reserve storage in addition to bunker storage.

Note how new G-W system can take coal directly from track hopper—(1) through crusher to apron feeder, then by belt conveyor to boiler house bunker, or—(2) by bucket elevator and swivel chute to ground storage. Coal is reclaimed by drag scraper from ground storage and conveyed to bunker by use of the *same* system.

But this is only one of scores of instances where G-W took over the complete job—design, construction and erection . . . shouldered all responsibility. For G-W materials handling experience dates back 140 years . . . definite assurance that consultation with a Gifford-Wood engineer can help *you* solve *your* coal handling problems.

G-W HANDLES IT . . .
faster • easier cheaper

SINCE 1814

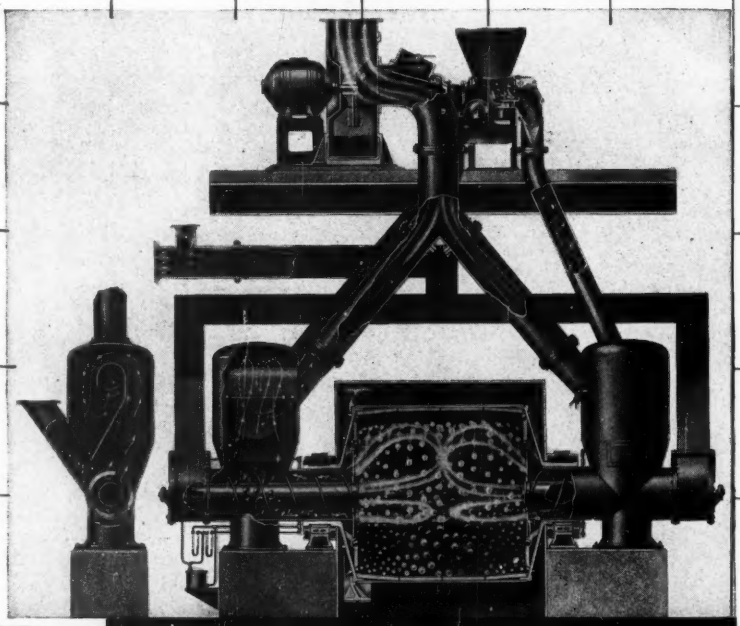
GIFFORD-WOOD CO.

NEW YORK 17
420 LEXINGTON AVENUE

Factory:
Hudson, N. Y.

CHICAGO 6
565 W. WASHINGTON ST.

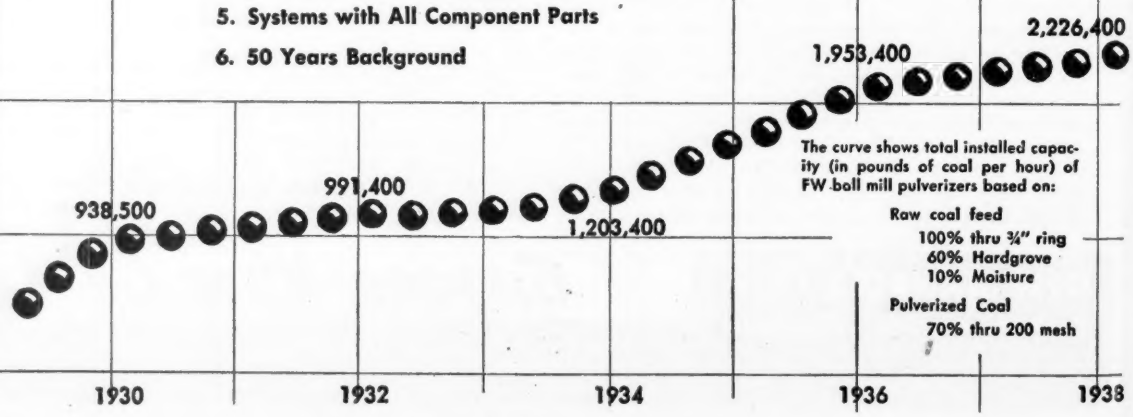
The FW Ball Mill keeps pace



The FW ball mill pulverizer provides one of the most effective methods of pulverizing hard or abrasive fuels. Its rapidly increasing use testifies to its efficiency, availability, and economy of operation.

Outstanding Features

1. Large Reserve Capacity
2. High Availability—Low Maintenance
3. Constant Fineness
4. Successful Installations for Pulverizing
   a. Anthracite Coal b. Bituminous Coal
   c. Coke Breeze d. Lignite e. Petroleum Coke
5. Systems with All Component Parts
6. 50 Years Background



The curve shows total installed capacity (in pounds of coal per hour) of FW ball mill pulverizers based on:

Raw coal feed
100% thru ¾" ring
60% Hardgrove
10% Moisture

Pulverized Coal
70% thru 200 mesh

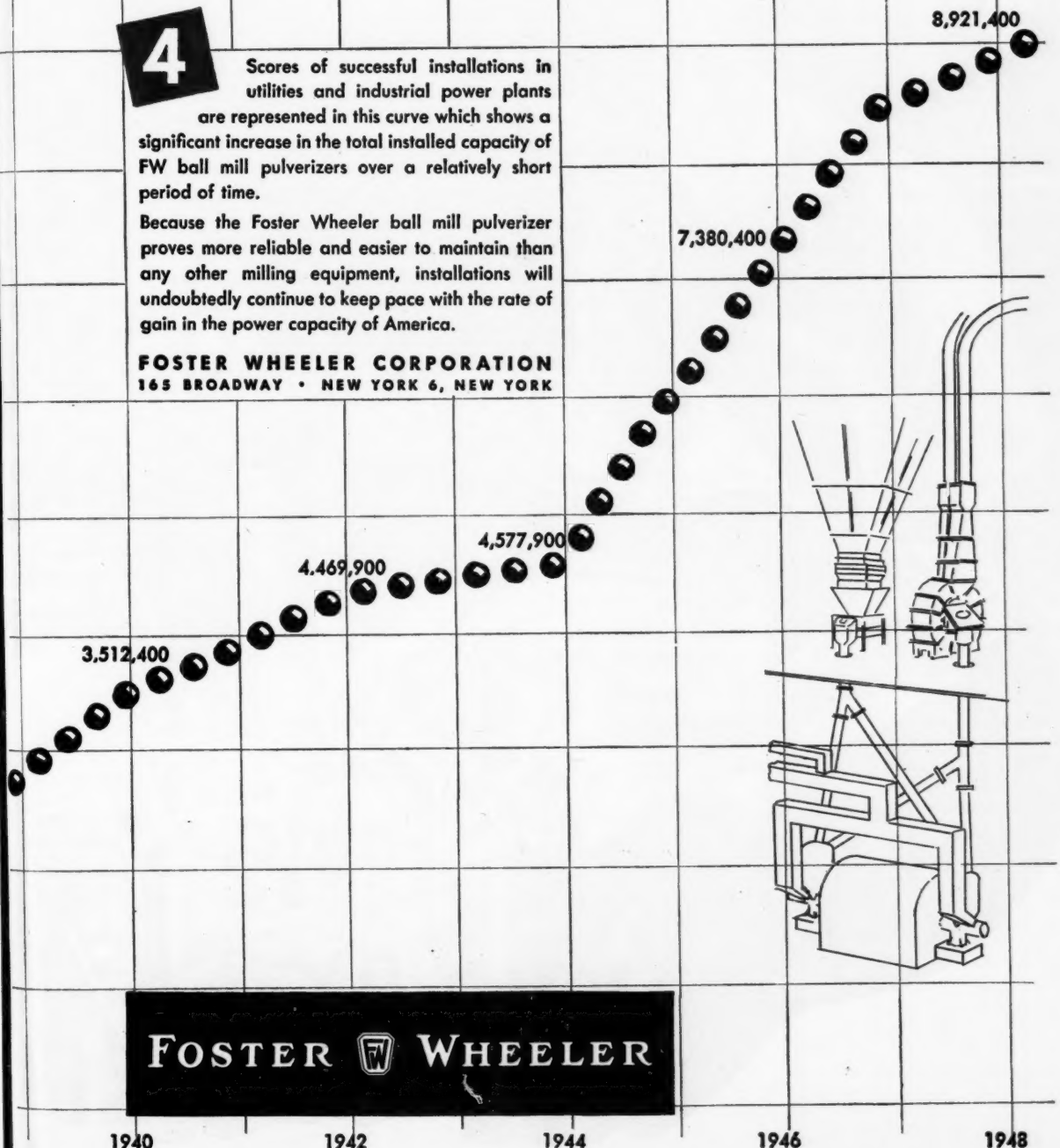
with Power Needs!

4

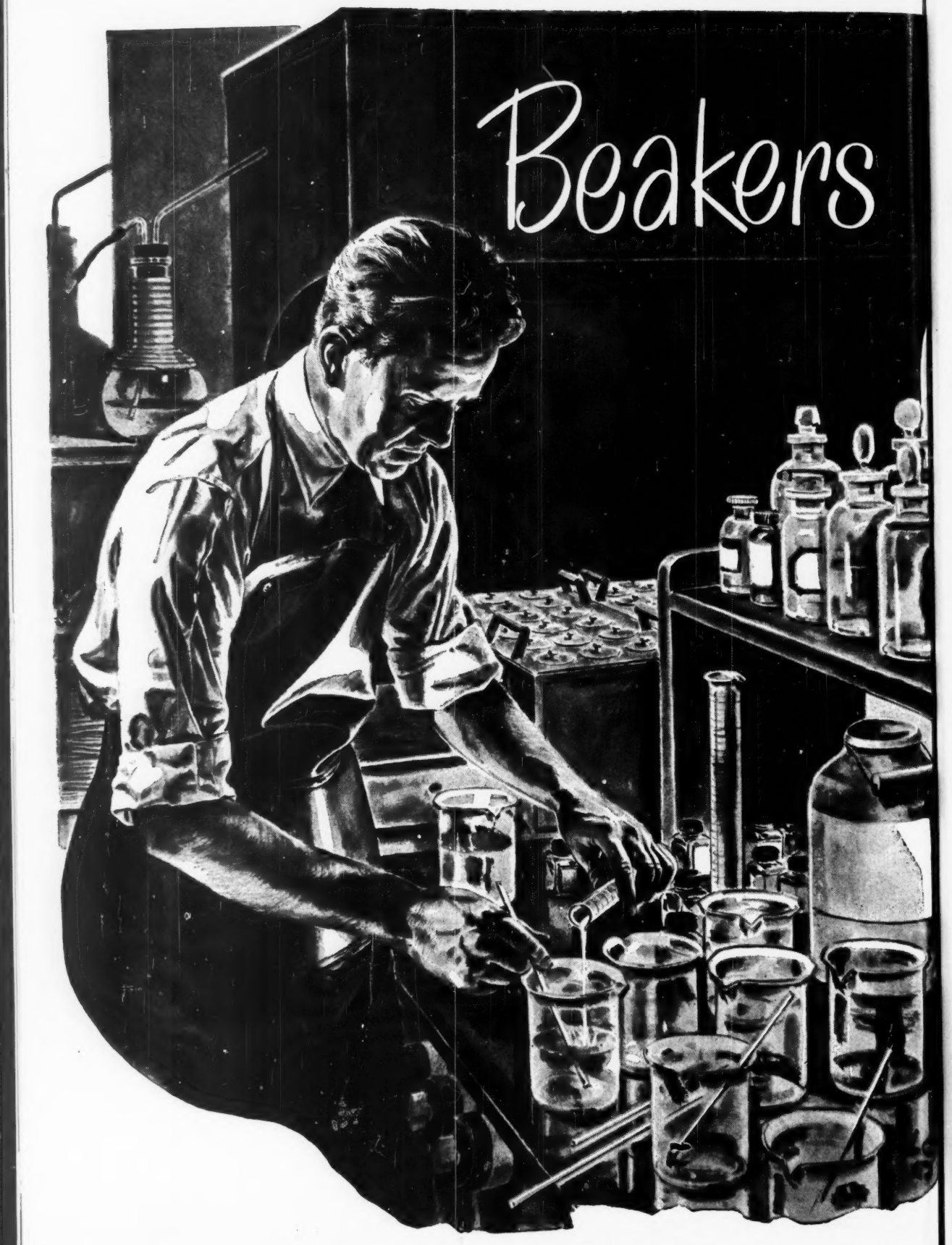
Scores of successful installations in utilities and industrial power plants are represented in this curve which shows a significant increase in the total installed capacity of FW ball mill pulverizers over a relatively short period of time.

Because the Foster Wheeler ball mill pulverizer proves more reliable and easier to maintain than any other milling equipment, installations will undoubtedly continue to keep pace with the rate of gain in the power capacity of America.

FOSTER WHEELER CORPORATION
165 BROADWAY • NEW YORK 6, NEW YORK



FOSTER WHEELER



Ever
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and Boiler tubes

Everyone concerned with boiler operation today realizes that steam generation inevitably involves a complex chemical problem. Water itself and the impurities which it may contain; the chemicals required for treatment; the materials of which the boiler and other components of the steam generating system are made; the compounds formed by interaction of these varied substances—all these and many other factors enter into the problem.

It is a problem which must be attacked by many methods, and one of the most important of these is *chemical analysis of deposits in boilers.* Such analysis shows, for example, the extent to which constituents of a tube deposit are sludge components, boiler scales, or corrosion products. It measures the extent to which the ordinary calcium compounds are admixed with the less common ones of zinc or the really unusual ones of barium and strontium. It will reveal the amount of magnesium present and give some information about the form in which it has been precipitated.

These and other facts brought out by chemical analysis may be of great importance in assaying current conditions and evaluating immediate problems and potential difficulties. From the results, corrective procedures, if necessary, can be set up..

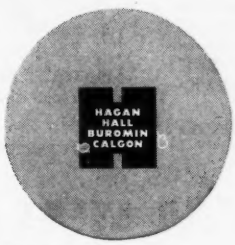
In Hall Laboratories, chemical analysis of deposits is primarily quantitative analysis, and is supplemented by microscopic, x-ray, spectrographic and other methods. Thus Hall engineers get the fullest possible information on all factors involved in your problem—and this thoroughness is one reason why Hall service is used continuously by so many plants, of all types and sizes, in all parts of the country.

Hall Laboratories, Inc., Hagan Building, Pittsburgh 30, Pennsylvania.

HALL LABORATORIES, INC.

(A Subsidiary of Hagan Corporation)

CONSULTANTS ON
INDUSTRIAL WATER TREATMENT
HALL SYSTEM OF BOILER WATER CONDITIONING
INDUSTRIAL WASTE RECOVERY AND DISPOSAL



SUN "JOB PROVED" PRODUCTS CUT COSTS,

Sun products have been "Job Proved" in the lubrication of almost every type of mining, manufacturing, power, and transportation equipment . . . in refrigeration and air-conditioning . . . in metal cutting, tempering, and quenching . . . in the processing of textile fibers, leather, natural and synthetic rubbers . . . in the impregnation of electrical, electronic, and packaging materials of many kinds.

To help you solve your production problems, Sun Oil Company offers a wide selection of "Job Proved" petroleum products, plus the experience of Sun Engineers. Their know-how and detailed product information are yours for the asking. Call your local Sun office, or write Dept. PN-1.

SUN OIL COMPANY • PHILADELPHIA 3, PA.

In Canada: Sun Oil Company, Ltd., Toronto and Montreal

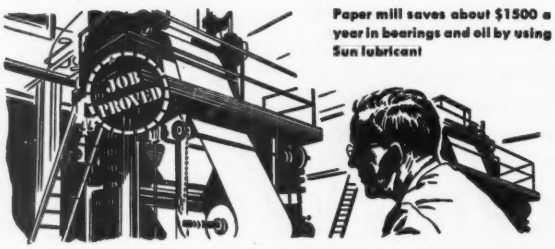
INDUSTRIAL OILS

SUNVIS 900 OILS—High-viscosity-index, paraffinic-type oils—of uniform O F pour point—fortified against rust, corrosion, oxidation, and sludge. The finest available lubricant for turbines, hydraulic systems, and similar applications.

SUNVIS HD 700 OILS—High-viscosity-index oils containing additives which minimize oxidation and give detergency. Ideal lubricants for internal combustion engines subjected to continuous heavy loads under the most adverse conditions.

SUNVIS OILS—Solvent-refined paraffinic-type oils of uniform high viscosity index, low pour point, and low carbon content. Especially suitable for application to long-time use in all types of industrial reservoirs and circulating systems.

DYNAVIS OILS—Low-pour-point, high-viscosity-index, inhibited oils, containing an additive which helps prevent formation of harmful corrosive and sludge-forming acids. Well suited for engines fitted with alloy bearings and operated at high temperatures.



Paper mill saves about $1500 a year in bearings and oil by using Sun lubricant

SOLNUS OILS—Well-refined straight mineral oils. Stand up under hard use for long periods of time. Recommended for use in machine tools, air compressors, certain types of diesels, etc.

CIRCO OILS—Used for general lubrication of industrial machinery when straight mineral oils are required.

SUNTAC OILS—100%-petroleum products which have been compounded to increase their adhesiveness. Recommended for general lubrication of all machines subjected to sudden shocks and load reversals. Cling to the parts to be lubricated.

STEAM CYLINDER OILS—High flash and fire point lubricants for either saturated or superheated steam conditions and for worm-gear speed-reduction units.

SUN CAR JOURNAL OILS—Dark oils meeting A.A.R. Specifications. For use in waste-packed bearings of railroad equipment.

SUN DELAWARE OILS—Dark oils for general lubrication on older types of industrial machinery.

SUNOCO WAY LUBRICANT—For use on tableways. Eliminates chatter and scoring . . . resists corrosion. Has good metal-wetting and adhesive properties, ample viscosity, and E. P. qualities.

SUN MARINE ENGINE OILS—Compounded with special emulsifying agents in order to provide adhesion to, and lubrication of, working parts in the presence of water. For the lubrication of bearings, eccentrics, crossheads, and various other parts of steam engines.

ROCK DRILL OIL—High-film-strength adhesive oil. For use in jackhammers, stopers, drifters, and similar equipment.

INDUSTRIAL GREASES

SUN CUP GREASES—Water resistant. For grease-cup and grease-gun application when service is normal.

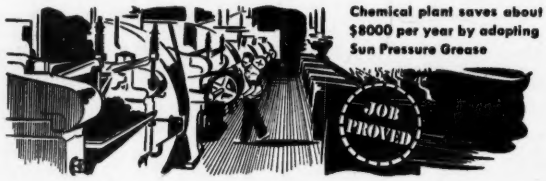
SUN GUN GREASES—Smooth greases made with medium-viscosity oil. Stable under pressure in power and booster guns.

ADHESIVE PRESSURE GREASES—Won't drip or splash. Excellent lubricants for open-gear applications.

SUN DARK PRESSURE-SYSTEM GREASES—For power-driven central grease lubricating systems in heavy industries. Also used as a "medium cup grease."

SUN MINE CAR GREASES—Available in several grades. Suitable for both antifriction bearings and plain-bearing cavity-type wheels.

SUN MINING MACHINE LUBRICANT—Semifluid. For use where a light but adhesive grease is required. Resists separation and decomposition.



Chemical plant saves about $8000 per year by adopting Sun Pressure Grease

SUN ROLLER BEARING GREASES—For use on electric motors and generators and high-temperature machinery equipped with ball or roller bearings.

SUN GEAR COMPOUNDS—Black adhesive open-gear compounds and

"JOB PROVED" IN EVERY INDUSTRY

SUN PETROLEUM

SPEED PRODUCTION, IMPROVE QUALITY

wire-cable greases. Recommended for power presses, mining machinery, worn reduction mills, crushers, pump gears, etc.

SUNOCO TRACTOR ROLLER COMPOUND—For crawler-type tractors. Provides good lubrication with exceptional sealing qualities.

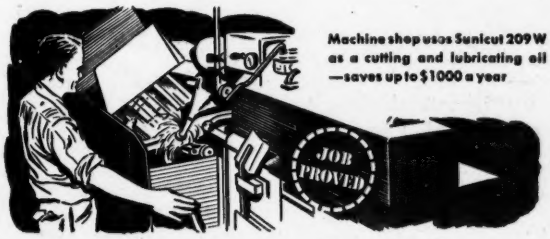
METALWORKING OILS

SUNICUT—Straight (non-emulsifiable) transparent cutting oils. Recommended for automatic screw machines and heavy-duty machining operations. Permit high speed production with excellent finishes, long tool life.

SUNOCO EMULSIFYING CUTTING OIL—A self-emulsifying oil which produces a stable white emulsion. Efficient and economical cooling and lubricating medium for turning, milling, drilling, and other metalworking operations on both ferrous and nonferrous metals. It is also an excellent grinding coolant.

SUN QUENCHING OILS—Specially refined oils designed to aid development of maximum physical properties in a wide variety of steels.

SUN TEMPERING OILS—Specially refined oils for tempering steel. Because of their low carbon content and stability under heat, these oils have an unusually long service life.



Machine shop uses Sunicut 209W as a cutting and lubricating oil—saves up to $1000 a year

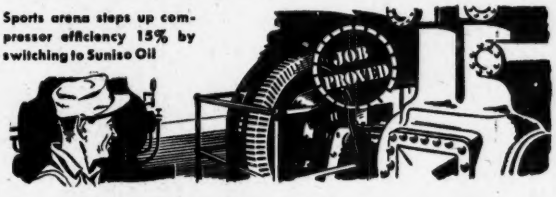
SUN ROLLING OILS—Straight and emulsifying oils which will permit maximum production in rolling steel, aluminum, brass, and copper.

SUN ANTI-RUST COMPOUNDS—Petroleum-base oils with chemical additives designed to prevent the rusting and corrosion of steel.

REFRIGERATION OILS

SUNISO REFRIGERATION OILS—Have extremely low pour points, extremely low wax-separating characteristics, a high degree of stability and long life. Initially neutral and resistant to formation of detrimental acids under service conditions. Suniso Oils are high quality oils suitable for both high- and low-temperature operations. The most widely used oils in refrigeration and air-conditioning.

Sports arena steps up compressor efficiency 15% by switching to Suniso Oil



TEXTILE-PROCESSING OILS

SUNOTEX TEXTILE OILS—Designed to impart certain additional properties to various forms of fibers during their processing from the fiber state into a manufactured product. All Sunotex textile oils are emulsifiable in water. Highest rating in fadometer tests.

SUN COTTON CONDITIONING OILS—Pale mineral oils which condition the cotton. They prevent waste by cutting down excessive amounts of "fly" (fine air-borne lint particles).

Worsted mill obtains easier scouring, better quality, larger yield with Sunotex WO-220

SUN ASBESTOS FIBER CONDITIONING OIL—Used for spraying on the asbestos during processing. Fibers are kept from being damaged or broken down, and harmful dust is minimized when this product is used.

SUN CORDAGE OILS—Generally used alone, but are adaptable to various formulas used by cordage manufacturers. Selected products, highly compatible with additives.

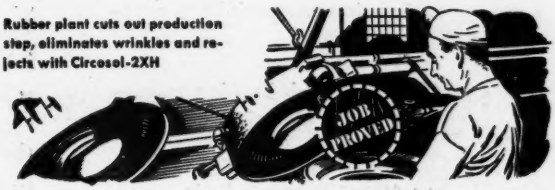
RUBBER-PROCESSING AIDS

CIRCOSOL-2XH—An elasticator and processing aid for natural rubber and especially for GR-S. Outstanding for sponge rubber.

CIRCO LIGHT PROCESS AID—A processing agent and excellent softener for natural rubber, natural rubber reclaims, and neoprene synthetic rubber. Used for GR-S to some extent.

SUNDEX-54—An inexpensive product suitable for processing GR-S and blends of GR-S and natural rubber. An established processing aid for rubber footwear stocks and semihard rubbers.

Rubber plant cuts out production step, eliminates wrinkles and rejects with Circosol-2XH



CIRCOMAR-5AA—A black-colored product for processing natural and GR-S rubber used in tire-making. Also used in reclaiming natural-rubber scrap. Replaces asphalt fluxes. Free-flowing at room temperature.

WAXES

Sun's new wax plant will be completed in 1949. Its many refining innovations and extreme flexibility will permit new types of waxes to be manufactured in large quantities—a procedure heretofore impracticable. A wide range of fully refined paraffin and microcrystalline waxes will be "tailor-made" to meet the requirements of virtually all major industrial applications. Pilot plant samples of several grades are now available.

MISCELLANEOUS INDUSTRIAL PRODUCTS

SUN SOLVENTS—Sun Spirits for the thinning of paints, varnishes, and enamels, and for metal-cleaning . . . a pure, water-white petroleum solvent free of corrosive sulphur. Other Sun solvents with special properties are available for the chemical industry.

SUN LEATHER OILS—Mineral-base leather oils. Used for obtaining the desired tensile strength, proper temper, and controlled moisture content. Maintain a light even color . . . mix well . . . distribute evenly.

"JOB PROVED" IN EVERY INDUSTRY

PRODUCTS

SUNOCO

INVESTIGATE
The Public Utility STOKER

Detroit RotoGrate is an advanced design of spreader stoker with forward moving grates that discharge the ash at the *front*. Intermittent cleaning of the fires and disturbance of uniform combustion is eliminated.

That's Why It:

1. **Burns any Bituminous Coal or Lignite with high efficiency.**
2. **Requires no special fuel preparation.**
3. **Permits high burning rates—increases capacity.**
4. **Maintains high CO_2 with or without preheated air.**
5. **Operates without clinker difficulties or slagging in the furnace.**
6. **Combustible loss in the ash pit is low.**
7. **Handles fluctuating loads—responds quickly to sudden changes.**
8. **High availability is assured.**

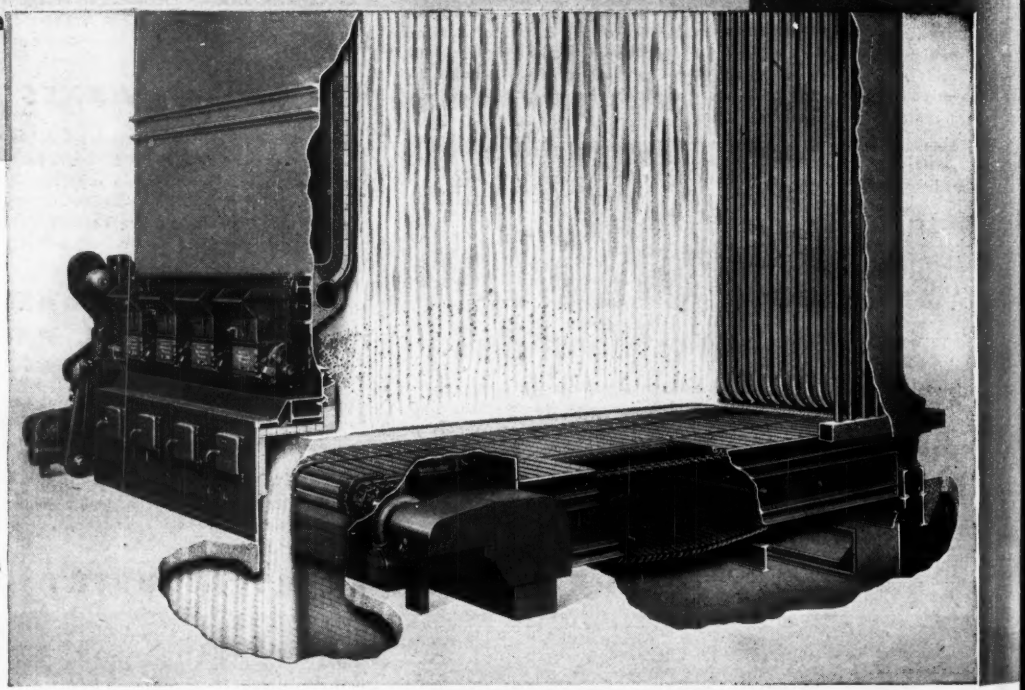
Northern States Power

Central Illinois

Ohio Public Service
Mahoningside

Central States Electric

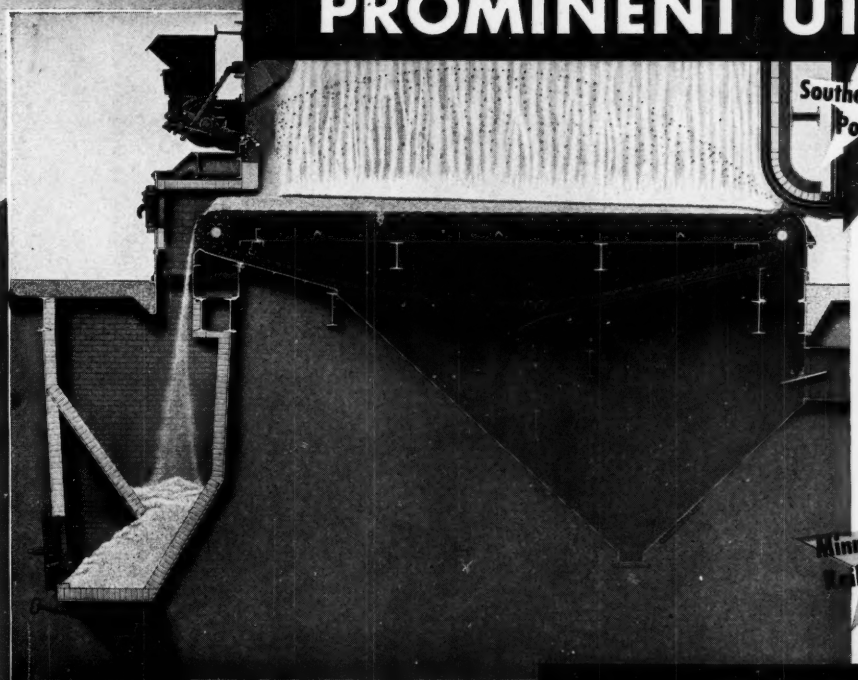
Central Iowa Power Cooperative



DETROIT ROTOGRATE

selected by these

PROMINENT UTILITIES



Southern Utah Power

Missouri Public Service

Sioux City Gas and Electric
Kirk Station

Minneapolis Street Railway Company

In the past 10 years... DETROIT ROTOGRATE STOKERS have revolutionized coal burning. Ask any user.

Otter Tail Power
Lake Sta

Public Service Company of Oklahoma

Montana-Dakota Utilities
Two Plants

Black Hills
er and

Lake Superior District Power
Bay Front Station

Indianapolis Power and Light
Perry W Station

Iowa Public Service
Six Contract
Five Plants

DETROIT ROTOGRATE STOKER

DETROIT STOKER COMPANY

GENERAL MOTORS BUILDING, DETROIT 2, MICHIGAN

WORKS AT MONROE, MICHIGAN • DISTRICT OFFICES IN PRINCIPAL CITIES

GARLOCK 90
WATERPROOF
HYDRAULIC
FLAX PACKING

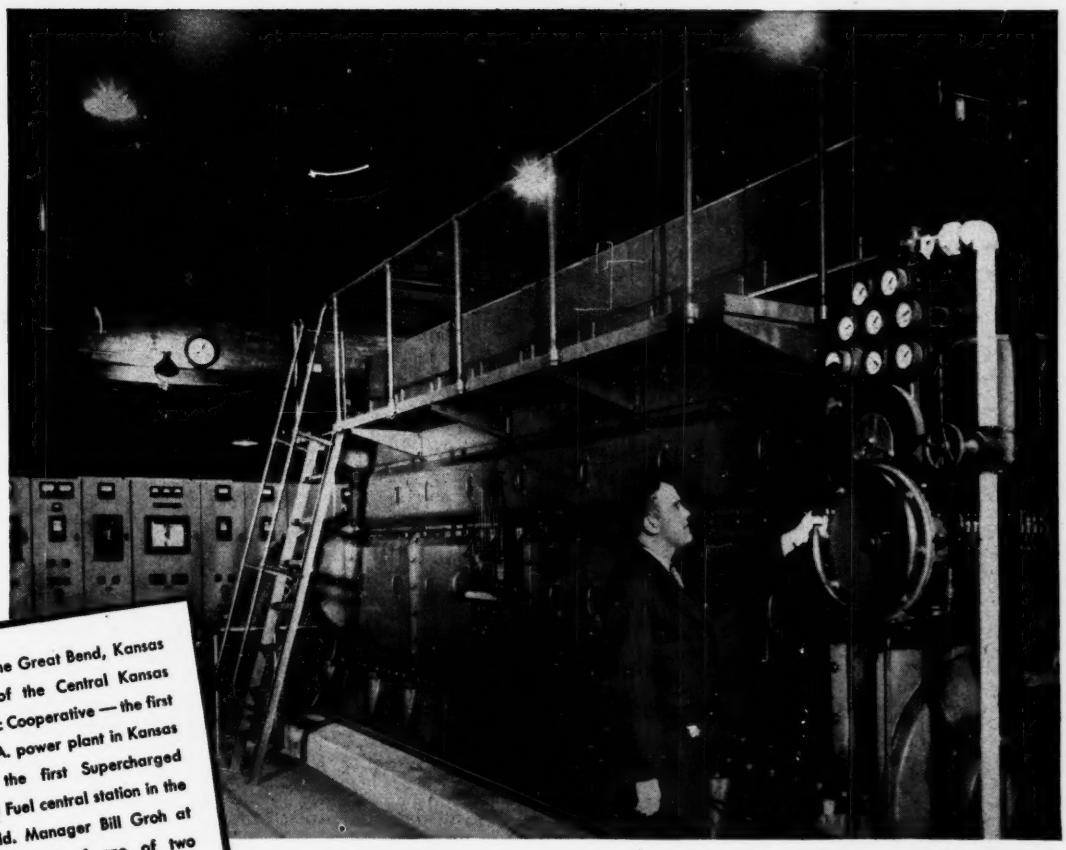
For heavy hydraulic service against cold water or oil—on plungers or rods of elevators, accumulators, hydraulic presses, outside packed pumps and other hydraulic equipment. All sizes from 1/8" to 2" packing space.

Long Fibres Mean Long Life

If a braided flax packing is made of No. 1 long fibre pure flax roving it will last longer and give better service than a packing made of shorter, cheaper fibres. That's why GARLOCK 90 Waterproof Hydraulic Packing lasts longer—it contains only the highest grade flax. It's dependable and it's economical!

THE GARLOCK PACKING COMPANY, PALMYRA, NEW YORK
In Canada: The Garlock Packing Company of Canada Ltd., Montreal, Que.

GARLOCK 90



Inside the Great Bend, Kansas plant of the Central Kansas Electric Cooperative — the first R. E. A. power plant in Kansas and the first Supercharged Dual Fuel central station in the world. Manager Bill Groh at the control of one of two Worthington Type SEHGO-8 Dual Fuel Diesel Engines.

"TOTAL FUEL AND LUBRICANT COST PER KWH—$0.0015+!"

Kansas R. E. A. Station Reports Steady Savings With Worthington Supercharged Dual Fuel Diesels

One way to get the real low-down on economical generation of electric power is from a progressive R. E. A. plant. Here, in part, is what the Central Kansas Electric Cooperative Association has to say about its Worthington Dual Fuel Diesel equipment:

"Our engines have run approximately 3050 and 4100 hours, respectively, under loads varying from 300 to 1160 KW. Operation has been satisfactory at all loads.

"One remarkable point is the low lubricating oil consumption . . . Also, we have had very little maintenance work.

"The past month the total fuel and lubricant cost per KWH generated has been 1.517 mills. . . . The saving of gas over fuel oil is very great.

"A fire necessitated shutting off our gas line for 12 hours. We switched to oil Diesel operation without any interruption."

Economy In Every Detail

With Worthington Dual Fuel Diesels you get outstanding thermal efficiency on the cheapest fuel available — oil, gas or oil-and-gas in any ratio — while Worthington's long leadership in developing Diesel design and performance means additional power for every operating-dollar you spend. For further proof that *there's more worth in Worthington*, contact *Worthington Pump and Machinery Corporation, Engine Division, Buffalo, N. Y.*

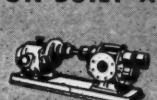
WORTHINGTON

YOUR PARTNER IN POWER PROGRESS

Diesel engines, 150 to 2,640 hp . . . gas engines, 175 to 1,720 hp . . . dual fuel engines, 225 to 2,640 hp.

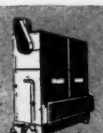
WORTHINGTON-BUILT AUXILIARIES

Balanced Angle Compressors



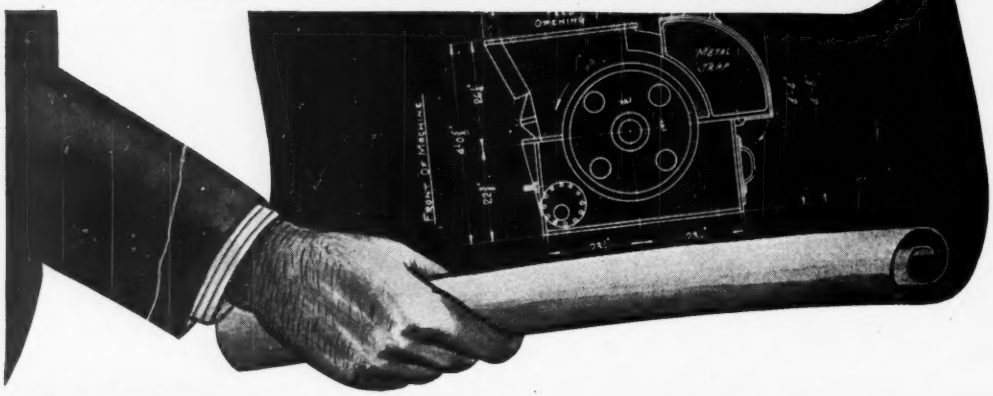
Oil Transfer Pumps

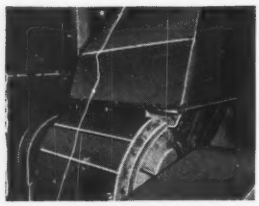
Cooling Water Circulating Pumps

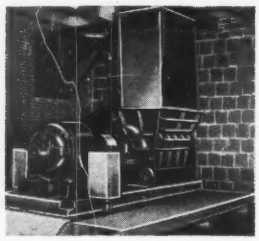


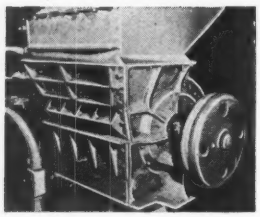
Evaporative Type Engine Water Cooler

1949 DESIGN FOR MORE EFFICIENT COAL PREPARATION







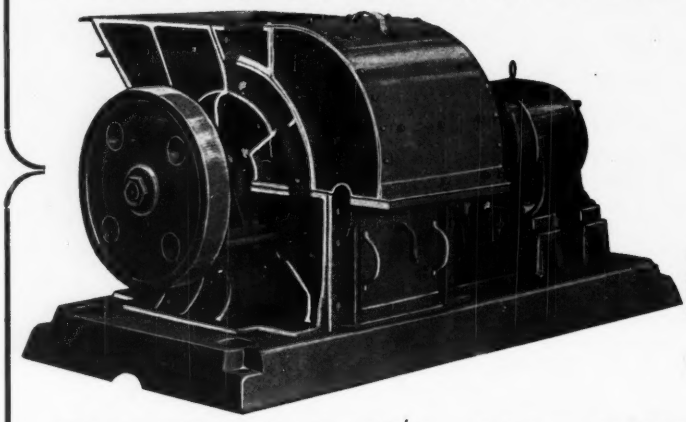


Changing over to Americans is easy because of their minimum headroom requirements and independence from auxiliary equipment.

AMERICAN *Rolling Ring* CRUSHERS

Reduces up to 500 TPH at less than 1c per ton!

With the constant demand for more kilowatt output, getting the most BTU's from each pound of coal is directly related. Here's where coal preparation enters into the efficiency of power production and that's where the American Crushers can improve your efficiency. The American Rolling Ring Crusher reduces ROM Coal to uniform size for efficient firing.



The basis for greater crushing efficiency is the manganese—shredder rings — exclusive with American.

The patented shredder ring action of Americans, through splitting instead of crushing coal results in a uniform product with controlled fines. For stoker feed sizes down to ¼" fines are minimized to the point that subsequent screening is not required to obtain a product that permits a loose firebed that responds to sudden steam demands—admits oxygen for efficient burning and yet does not have excessive ashpit drop.

The fineness to which Americans will grind pulverizer sizes without oversize reduces the load on the ball grinders and increases preparation efficiency in pulverizer feed operations.

The American bulletin "Crushing Coal for Less Than 1c Per Ton" is yours for the asking. Write for it.

American PULVERIZER COMPANY

Originators and Manufacturers of Ring Crushers and Pulverizers

1429 MACKLIND AVE.
ST. LOUIS 10, MO.

WICKES type "S" standard two drum unit

the WICKES Boiler Co.

SAGINAW, MICHIGAN

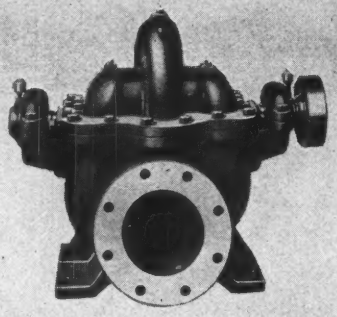
The Wickes Type "S" Standard 2-Drum Unit is designed for industrial plants and particularly where operating and maintenance forces are small. This unit has a generating capacity of 15,000 to 50,000 lbs. steam per hour. It is adaptable to any standard method of firing—oil, gas, single retort underfeed stoker, or spreader stoker, and should the fuel market change, any of the above methods of firing may be readily substituted. With the Type "S" Unit, space conditions are no problem, since the design of the furnace makes this unit a low head boiler. The depth, width and distance between drum centerlines being variable in the standard design, virtually any space situation can be met. Your boiler problems will receive our engineers' consultation and recommendation without obligation.

SALES OFFICES: Atlanta • Boston • Charlotte, N. C. • Chicago • Cincinnati • Denver • Detroit • Houston • Indianapolis • Kansas City • Los Angeles • Milwaukee • New York City • Pittsburgh • San Francisco • San Jose • Seattle • St. Louis • Tulsa • Saginaw • Mexico City • Buenos Aires.

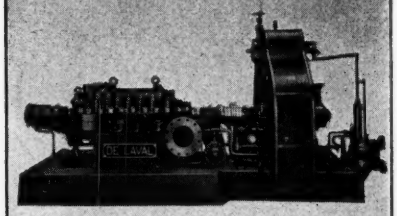
DIVISION OF THE WICKES CORPORATION • RECOGNIZED QUALITY SINCE 1854

De Laval Centrifugal Pumps

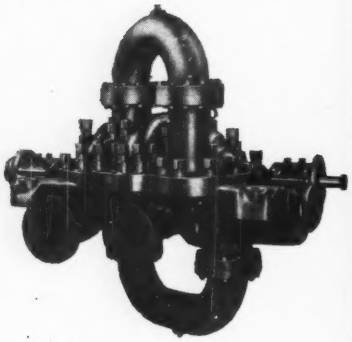
for all purposes



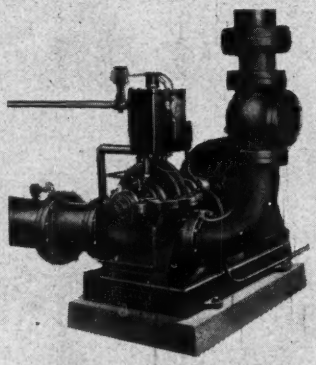
SINGLE STAGE, DOUBLE SUCTION PUMP made in capacities ranging from less than 100 gpm to upwards of 75,000 gpm.



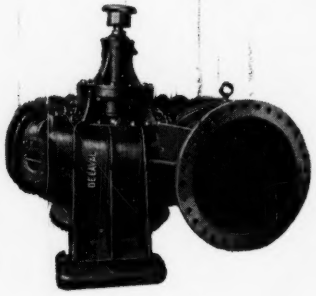
1600 PSI BOILER FEED PUMP. Designed for trouble free, high pressure, high temperature service.



FOUR STAGE, OPPOSED IMPELLER PUMP. Built in two to six stages, for pressures up to 1000 psi.

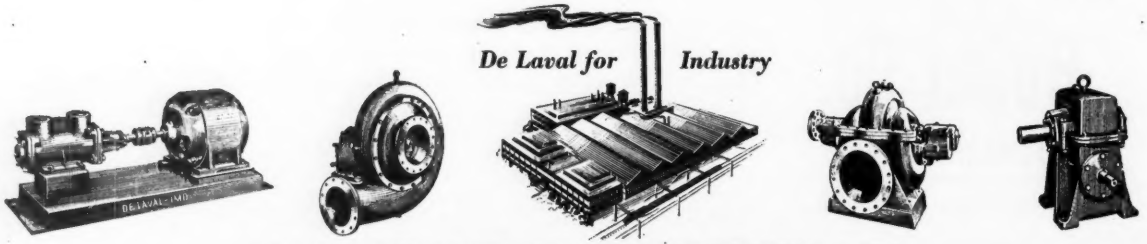


SELF-PRIMING PUMPING SYSTEM. Automatically keeps pump primed at all times.



MIXED FLOW PUMPS. For handling large volumes at relatively low heads.

For over forty years De Laval has pioneered in the development of centrifugal pumps for almost every class of liquid-handling service. De Laval was the first to demonstrate the advantages of accessible, horizontally-split casings, high speeds, leak-minimizing Labyrinth Wearing Rings and other design features of undisputed value.



DE LAVAL STEAM TURBINE COMPANY, TRENTON 2, N. J.

GP-3

TURBINES • HELICAL GEARS • WORM GEAR SPEED REDUCERS • CENTRIFUGAL PUMPS • CENTRIFUGAL BLOWERS AND COMPRESSORS • IMO OIL PUMPS

"We had a real Problem on our hands

. . . how to get maximum productive energy from our fuel without uselessly heating excess air."

"This remarkable Cities Service Heat Prover quickly solved our problem"

SCORES of large industrial plants have found this exclusive Cities Service Heat Prover Service a tremendous help in uncovering facts vital to efficient production such as:

1. How much energy is wasted in uselessly heating excess air?
2. How much excess oxygen is present in furnace gases?
3. What percentage of fuel is converted into productive energy?

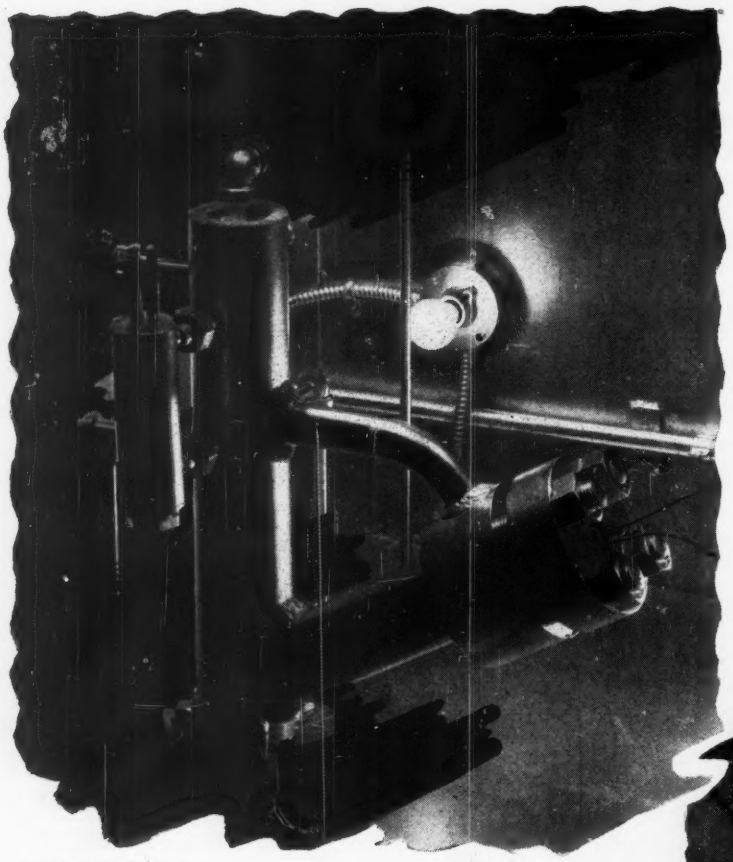
The Cities Service Industrial Heat Prover answers these questions quickly and accurately. Moreover, the instrument has been developed for use on industrial furnaces of every design regardless of the type of fuel used.

Write today for a free demonstration. There is no charge, or obligation.

Free

A fact-filled booklet entitled "Combustion Control for Industry." Write Cities Service Oil Company, Sixty Wall Tower, Room 296, New York 5.

CITIES SERVICE



This Nalco test boiler, a 3,000 p.s.i. unit, is only 36 inches high! (Photo in Nalco Laboratories, before completion of insulation.)

3000 p.s.i.

is closer than you think!

...AND *Nalco* IS READY FOR IT!

Steam generators operating at pressures up to 3,000 p.s.i. may be years away in practical use—but, test boilers in the Nalco Laboratories are operating at 3,000 p.s.i. *now*...helping to open the way to water treatment in the super-high-pressure range which will be as successful as the present Nalco System in thousands of plants having pressures from 0 to 2,500 p.s.i.

Whatever your boiler and plant operating conditions, the Nalco policy of keeping ahead in *successful* water treatment assures you of permanent results when the Nalco System goes to work for you.

This is Nalco, a 32-page, full-color bulletin describing the Nalco facilities available to you, is yours for the asking — call your Nalco Representative, or write direct.

Steel test tubes, taken from Nalco test boilers, accurately show scaling and corrosion effects of various water samples. From such tests, data leading toward new and better water treatment methods are obtained.

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THE *Nalco* SYSTEM • **Serving Industry through Practical Applied Science**

HELPFUL BULLETINS

Answers to many operating and maintenance problems will be found in these new bulletins and catalogs. List paragraph numbers of those you want on coupon below, detach and mail

BOILERS, AUXILIARIES

1 **Heat Exchangers Data Book**—Illustrations and pertinent data on the company's complete line of redesigned heat exchangers are presented in Bulletin 1.1K1. This 8-page booklet presents cut-away views illustrating construction and line drawings showing sizes, dimensions and weights. Brief text on various applications of this all-nonferrous unit is presented. Ross Heater & Mfg. Co., Inc.

2 **Water Tube Boilers**—Bulletin B-3200A is a new 10 page technical boiler bulletin. According to the manufacturers the curves and specification and selection charts which appear in this new bulletin make it the most complete piece of literature of its type ever published. Included with engineering drawings of standard and specially designed 3 drum water tube boilers are charts showing performance ratings, complete specification tables and typical installation photographs. On a double-page fold-in typical setting diagrams for a 3-drum boiler arranged for oil firing and for a battery of 3-drum boilers with an underfeed stoker are enlarged so that they are easy to read and can be readily used by engineers for writing in their own specifications. On another double page fold-in is an engineering diagram of the standard model 3 drum water tube boiler produced by the company. This is accompanied by an easily read weather selection chart. Titusville Iron Works Company, Division of Struthers Wells Corporation.

ELECTRICAL

3 **Network Protection**—This company's new overhead network protector for reliable low-cost operation in small outlying business sections, heavily-loaded residential areas, and commercial districts in small cities is described in this new bulletin A-48311. The booklet discusses the economic advantages of this low voltage, AC network system over the conventional network system. Wiring diagrams, photographs, and cutaway views are used in the 24 page booklet to explain construction and operating characteristics of the unit. Westinghouse Electric Corp.

4 **Substation Transformers**—Construction details and performance features of the company's substation transformers for rural and industrial service in ratings from 50 to 500 kva are covered in this new 8 page Bulletin 61B6014A. The bulletin includes a description of core and coil construction of the units, tank design and construction, and a dimension table for the 50 to 500 kva, single phase, 60 cycle, 50 deg rise transformers in classes ranging from 2400 to 66,000 volts. Allis-Chalmers Manufacturing Company.

PUMPS, COMPRESSORS

5 **Condensate Return Units**—Section 199 is a catalog insert which describes this company's "Packaged" condensate return unit. Complete descriptions of the unit are presented along with specifications and selection tables. Outstanding features of the unit are described and illustrated. Roy E. Roth Co.

6 **Engines, Pumps**—This is a unique bulletin which has just been produced. It is unique in that the entire bulletin is made up of a complete fold-in unit which presents in a straight line a photograph of the unit under discussion, the engine designation, its range of sizes, description of design and construction and main application. The booklet should be of exceptional help to all engineers interested in engine and pump application. The Cooper-Bessemer Corporation.

7 **Centrifugal Boiler Feed Pumps**—Bulletin W-319-BIC describing high pressure, high temperature centrifugal boiler feed pumps has been announced. The bulletin contains 12 pages and gives complete information, including parts photographs, and similar information. Worthington Pump and Machinery Corporation.

INSTRUMENTS AND CONTROLS

8 **Thermocouple Manual**—This complete new thermocouple manual, Bulletin T/C 7 has just been released. Containing 40 pages, this illustrated manual provides information on selection of proper thermocouples and protecting tubes, methods of checking thermocouples and pyrometers and installation data. It describes and lists current prices on thermocouples, thermocouple wire, lead wire, heads, connectors, plugs and socket assemblies, insulators, protecting tubes and radiation heads. Included in the engineering data are temperature-millivolt curves, resistance tables, pipe and wire sizes and lead wire conduit capacity. Wheelco Instruments Company.

9 **Torquemeters**—Bulletin 275 covers four standard models of the company's torquemeters of 2000, 5000, 12,000 and 30,000 in. lb capacity based on SR-4 bonded resistance wire strain gages, specially designed torquemeters for capacities of 30 to 750,000 in. lb capacities and instrumentation for indicating and recording torque measurements. The bulletin tells how to specify torquemeter requirements and shows how the torquemeter works. Testing Equipment Dept., Baldwin Locomotive Works.

10 **For Industrial Signalling**—This new folder describes a new audible-visual Annunciator for industrial and public utility signalling purposes. Complete operating information covering two types of Annunciators is presented together with schematic wiring diagrams of both types. Dimensional drawings are also shown. The Autocall Co.

11 **pH and Conductivity**—pH and conductivity control and their application to different industrial processes is a feature of Catalog 15-12. Typical examples presented in the bulletin include pH control in heavy chemical industries, agricultural chemistry, electroplating, pulp and paper, research, food and steel industries, conductivity control in water treatment, power plants and the textile industry. It also offers a discussion of the fundamentals of pH, oxidation-reduction potential and conductivity and describes such instruments as the Electronik Potentiometer, Flow Electrode Assembly, the Beckman pH Amplifier and others. The 43 pages are well illustrated. The Brown Instrument Co.

12 **Tubular Rheostats Bulletin**—Bulletin 41 just released by this company describes the various styles of standard, screw drive, double, graded, switchboard, metal caged and non-inductive rheostats. There is a section on "How to Select" which shows diagrams and examples for the various applications of rheostats. The temperature rise and dissipating characteristics of these rheostats are discussed. Furthermore, charts are shown and examples given as assistance in the proper selection of these instruments. James G. Biddle Co.

13 **Combustion Control**—Bulletin 102-D describes this company's air operated combustion control. Containing 32 pages and bound in a heavy paper cover, the booklet describes completely the application to boilers fired with oil burners, stokers, to furnace draft control and points out its adaptability to any plant layout. Descriptions of the controllers themselves along with integral parts of the units are given. Typical installations of pulverized coal fired boilers are presented in a separate section of the bulletin. Installations on stoker fired boilers and on oil fired units also are given. Bailey Meter Company.

14 **Boiler Water Level Control**—Bulletin 487 describes completely the installation of boiler water level control equipment at the Blackhawk Generating Station, Wisconsin Power & Light Company. Photographs of the installation are presented as is a schematic layout of the entire station along with tabulated significant data. A large, full-page cross section of the B & W Type FH integral furnace boiler is presented and other drawings and photographs show the accompanying equipment. Northern Equipment Company.

VALVES, PIPING

15 **Rubber Expansion Joints**—This 8 page bulletin AD 137 tells about the application, construction, styles, service and advantages of the company's line of rubber expansion joints. Other information given, includes "How To Order" and a table of dimensions which is accompanied by dimensioned line drawings. The bulletin is well illustrated. The Garlock Packing Company.

16 **Valves Data Book**—This 72-page Catalog 48 presents comparison and selection charts which give a valve user a quick key to the proper safety and relief valve for each type of service. Triple capacity tables which give water, air and steam capacities for various nozzle orifice sizes, as well as a new tight vapor sizing chart, which enables a quick sizing of valves. Several new valves are described in the book along with the company's established line of safety and relief valves. Farris Engineering Co.

17 **New Steel Valves**—A whole new group of steel valve designs are described in this recently-issued folder. Outstanding features of the valves are described and sectional and installation photographs are presented. Edward Valves, Inc.

January, 1949

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PROPERTY MAINTENANCE

18 **Concrete Floors Q & A**—A new booklet titled Lumnite Concrete Floors—Corrosion Resistant and Heat Resistant, has just been published. The detailed information contained in this booklet brings up to date, the service experiences and late developments in this field. The information covers methods and materials used in placing corrosion resistant concrete in a wide variety of industrial applications. Typical uses of corrosion resistant concrete are listed for many industries and also given, are the answers to a number of questions often asked about it. A section on placing and finishing corrosion resistant floors will be helpful to prospective users. Lumnite Division, Universal Atlas Cement Company.

APPLYING METALS

19 **Forgings Data Book**—One of the most comprehensive reference data booklets on the subject of forgings is a new 44 page catalog recently published. Titled "The Improvement of Metals by Forging," the booklet describes in detail the various types and characteristics of forgings and discusses important considerations in designing for them. Tables present complete information on the characteristics and applications of commercial forging metals, including carbon and alloy steels, corrosion resisting steels and high temperature alloys. The Steel Improvement and Forge Company.

20 **How To Make Joints**—This is an informative folder on making bell and spigot joints. The folder describes and illustrates three methods by which tight and lasting joints of this type can be made with the company's compound, which has been developed specifically for the purpose. It explains in detail how the material is applied, and tells the quantity which should be used for different sizes of pipe. Smooth-On Manufacturing Company.

21 **Inert Gas Welding**—This process receives an important contribution in this new Bulletin 1.102. The new bulletin is most practical and helpful in its information to all who are using or contemplating use of helium, argon or atomic hydrogen arc welding. They include the smallest setups for welding to the largest and even manual types. Fansteel Metallurgical Corp.

22 **Welding Apparatus Catalog**—There are 40 pages in this beautifully done catalog, Form 20-B, covering the various gas welding sets, torches, flame cutting apparatus, regulators, meters, and other items of gas welding equipment in the company's line. Many of the illustrations are presented in natural four-color engravings. Descriptions of construction and operating features are detailed and illustrations are used generously. Victor Equipment Co.

WATER TREATMENT

23 **Rust Prevention Data Book**—This loose-leaf collection of data sheets covers the story of the company's various types of No-Ox-Id Protective Coatings. The first bulletin tells the general story of the characteristics of the protective coatings and the remainder give such data as: Physical Description; What It is Used For; Coverage; Preparation of Surface Before Application; Method of Application; Drying Time; Recommendations for Storage; Fire Hazards; Resistance; and others. Dearborn Chemical Co.

24 **Boiler Corrosion**—A 12 page article discussing the cause and prevention of corrosion in boiler systems is presented in Betz Technical Paper No. 111 titled "Corrosion: Its effect in Boiler Systems." The corrosive effects of oxygen, carbon dioxide, ammonia, hydrogen sulfide, acidity and physical factors are evaluated. Numerous illustrations, graphs and tables aid in understanding the article. W. H. & L. D. Betz.

25 **Pure Water at Low Cost**—The title of this recently issued 20 page booklet is "De-Ionizing Systems for Pure Water at Low Cost." The booklet is filled with diagrams, descriptions and photographs describing the construction and procedures of the equipment. Flow sheets, excellently done give further information on the use of the De-ionizing systems. One section "Operating Costs" will be of considerable interest to all engineers. Dearborn Chemical Company.

26 **Overcoming Salt Corrosion**—The part played by corrosion control in the use of brine solutions by chemical and food processors and by salt producers is described in this new 20 page booklet. Contents of the book are about equally divided between a discussion of corrosion problems solved by the two above-mentioned branches of industry. The book is filled with tabular data and photographs. The International Nickel Co., Inc.

27 **Water Conditioning**—Executives and engineers concerned with the treatment of water for general plant services, process work or steam generation will be interested in this new brochure. This publication outlines the background, facilities and processes and equipment offered by the company in the fields of water treatment and conditioning of other liquids. Included in it are references to more than 50 technical articles covering developments in this field which have been written by technical executives of the company. The brochure also contains illustrations showing plant facilities and installations of various types of the company's equipment. Liquid Conditioning Corporation.

28 **Application Data Bulletin**—Titled "The Aroclors," chlorinated biphenyl and chlorinated poly-phenyls, this booklet describes the unique properties which enables this material to fulfill certain requirements. The Aroclors have won a place in the electrical insulating field and in such widely differing applications as non-flammable hydraulic media, high-temperature and high-pressure lubricants, heat-transfer and expansion media, sealing compounds, adhesives and protective coatings, including plastics, pigments, lacquers, paints and varnishes. This booklet contains 28 pages and presents the combined information gathered by the company from what it believes it to be reliable and dependable sources. Monsanto Chemical Company.

29 **Stop Blade Deposits**—Identification and prevention of steam turbine blade deposits and boiler water conditioning to prevent such deposits are discussed in this new 16 page bulletin 28B7030. Described are the X-Ray diffraction methods employed by the company for identification purposes and the results obtained. Tables list the partial chemical analyses of deposits containing sodium disilicate, occurrence data on compounds found, composition of turbine deposits from turbines operating at various throttle pressures and temperatures, and comparison of compounds found in turbine blade deposits with boiler operating pressures. A prevention of turbine blade deposits, particularly those of silica, depend upon keeping the silica concentration in the boiler water sufficiently low so that the concentration in the steam is less than a tenth of a part per million, the bulletin points out. Allis-Chalmers Manufacturing Company.

30 **Steam Line Corrosion Control**—A new, illustrated booklet describing the action and application of the company's product has been announced. This product is used for the prevention of corrosion in steam lines, condensate and plant equipment. A method of determining the corrosiveness of steam is also covered. The booklet points out that the material is economical to use and is non-toxic. E. F. Drew & Co., Inc.

MISCELLANEOUS

31 **Coal Crushing, Sizing**—Bulletin 3007 describes the company's Bradford breaker a coal crusher, sizer and scavenger. The bulletin presents drawings of the breaker, tells how it works and then presents the complete story of its operation at the coal mine and coal cleaning plant at the By-Product Coke Plant and at the Power Station. The back section of the catalog presents engineering information on capacities, dimensions and dimensioned line drawings. Pennsylvania Crusher Company.

32 **Silicone Notebook**—This new booklet, Dow Corning Silicone Notebook, Fluid Series No. 3, contains the most comprehensive body of information available on the properties and behavior of the DC 200 Silicone Fluids. These semi-inorganic fluids are notable for their heat stability, shear resistance, relatively constant viscosity over a wide temperature range, lubricity, water repellency and good dielectric properties. Their usefulness as damping and hydraulic media, as liquid dielectrics, as special purpose lubricants or as additives, impregnants or coatings has been established in almost every field of industry. Dow Corning Corporation.

33 **Snow Removal**—Bulletin No. SL 522 is an attractive 2-color, 8 page Bulletin graphically describing operations and features of the company's new snow loader. Controls, various operating features and principles are adequately described. More than a piece of product literature, this booklet presents facts and figures to illustrate how the machine can pay for itself in one season by truck time savings alone. Barber-Greene Co.

34 **Dry Materials Conveyor**—Bulletin F-H-1 describes this company's revolutionary type of conveyor designed for the handling of fine, dry materials. The book, which contains 12 pages, presents excellent installation views of the conveyor, and also drawings which illustrate construction and method of operation. The Bulletin points out that the conveyor has no moving parts and that it has no hazards to workmen, is silent in operation, requires no lubrication and can pass around obstacles. Fuller Company.

35 **Separators and Exhaust Heads Data Book**—Catalog No. 500 has just been issued by this company. This data book is exceptionally well arranged, each page being a unit in which is described the particular item under discussion with included special information and dimensional data. Auxiliary or accompanying equipment is also mentioned in some cases. Considerable engineering data such as "Pressure Drop Chart" and directions for use, table of flow of steam in pipes, and other tabular and chart material. Wright Austin Company.

36 **Diesel Operation**—Bulletin 161 gives design and operating features of the company's four-cycle Diesel engiiness in 9 in. and 13 in. cyclinder sizes providing a power range from 150 to 1370 hp. (more) for a wide variety of services ranging from portable self-contained power units to permanent installations and auxiliary units. Specifications and dimensions of the units also are listed. Nordberg Mfg. Co.

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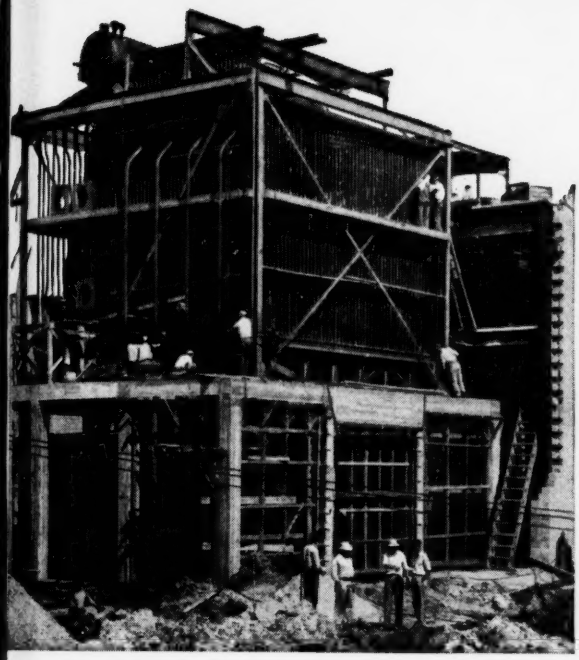

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WHEN you install a new boiler, you'll find it to your advantage to specify removal of the mill scale *after erection*, using Dowell Chemical Scale Removal Service. The Dowell method eliminates much of the extra care required in the handling of previously sand-blasted or pickled tubes—*and* many power engineers have found that the *chemical* removal of mill scale from new boilers before the first firing results in more satisfactory boiler operation.

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Edward

Motor operated angle stop valve (above) and globe non-return valve with Impactor handwheel and Equalizer (right) are typical of complete line of Edward pressure-seal bonnet valves for America's most modern high-pressure high-temperature power plants.

PRESSURE-SEAL VALVES

GIVE YOU THESE VITAL ADVANTAGES

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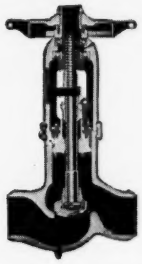
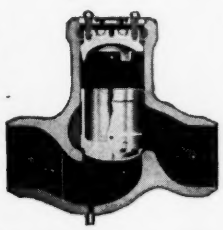


Edward pressure-seal stop valve of new streamlined globe design for lowest pressure drop.

NON-RETURN

Positive action angle non-return valve with new Edward hi-lift disk-piston and Edward Equalizer.

CHECK



New easy-opening, non-slamming pressure-seal check valve in globe pattern. Also built in angle pattern.

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- ***LASTING TIGHTNESS AT ANY TEMPERATURE***
  No bonnet joint leakage regardless of temperature or pressure variations.
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  Globe and angle stop, non-return and check valves and gate valves available in 900, 1500 and 2500 lb. pressure classes.
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  New body designs make use of smaller pipe and valves possible, cut pressure loss, save space, reduce weight, cut wear-producing turbulence.
- ***OTHER EDWARD DESIGN ADVANTAGES***
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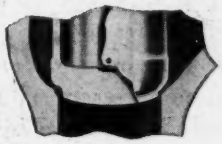

Ordinary valves with welded-in seat rings, by their design, put high stress concentrations on critical areas of the valve body, often causing cracking where there is low strength. Note in the drawing how the new Edward Intex seat designs avoid this. The hard-facing material, which forms the seat, is laid directly on the valve body and absorbs closing loads, reducing distortion and the shearing effect of high stress concentrations.

Edward Valves, Inc.

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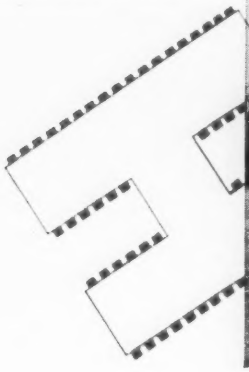

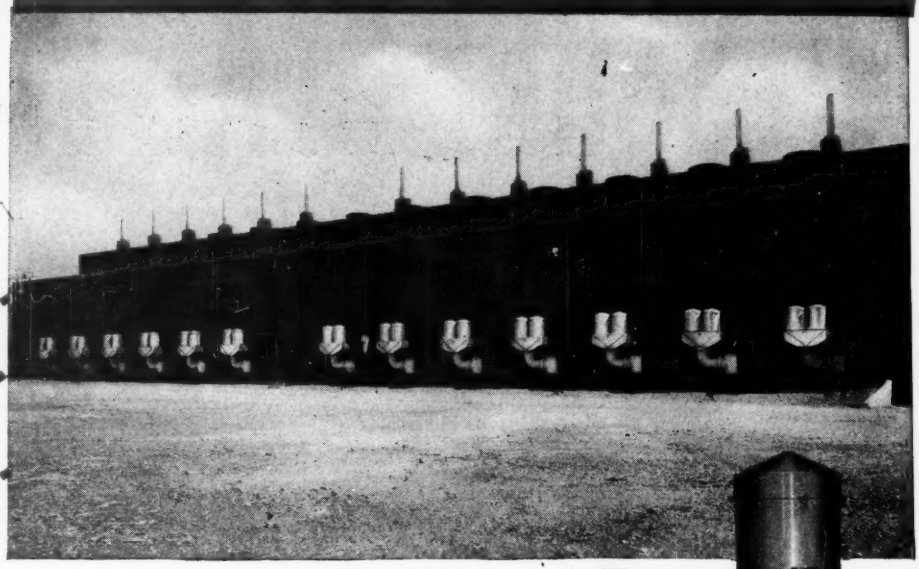

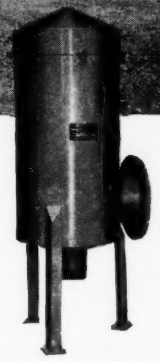

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Increase of back pressure is negligible, due to the initial low resistance (approx. ½" W.G. as rated) and the recognized ability of this type filter to shake off an excessive accumulation of dust.

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Model IDR: ALL the convenience of ground level installation plus the advantage of high level air intake. An exclusive design.

Model D: The standard intake filter for heavy duty service on large engines and compressors.

Model DS: Similar to the Model D with the addition of silencing tubes.

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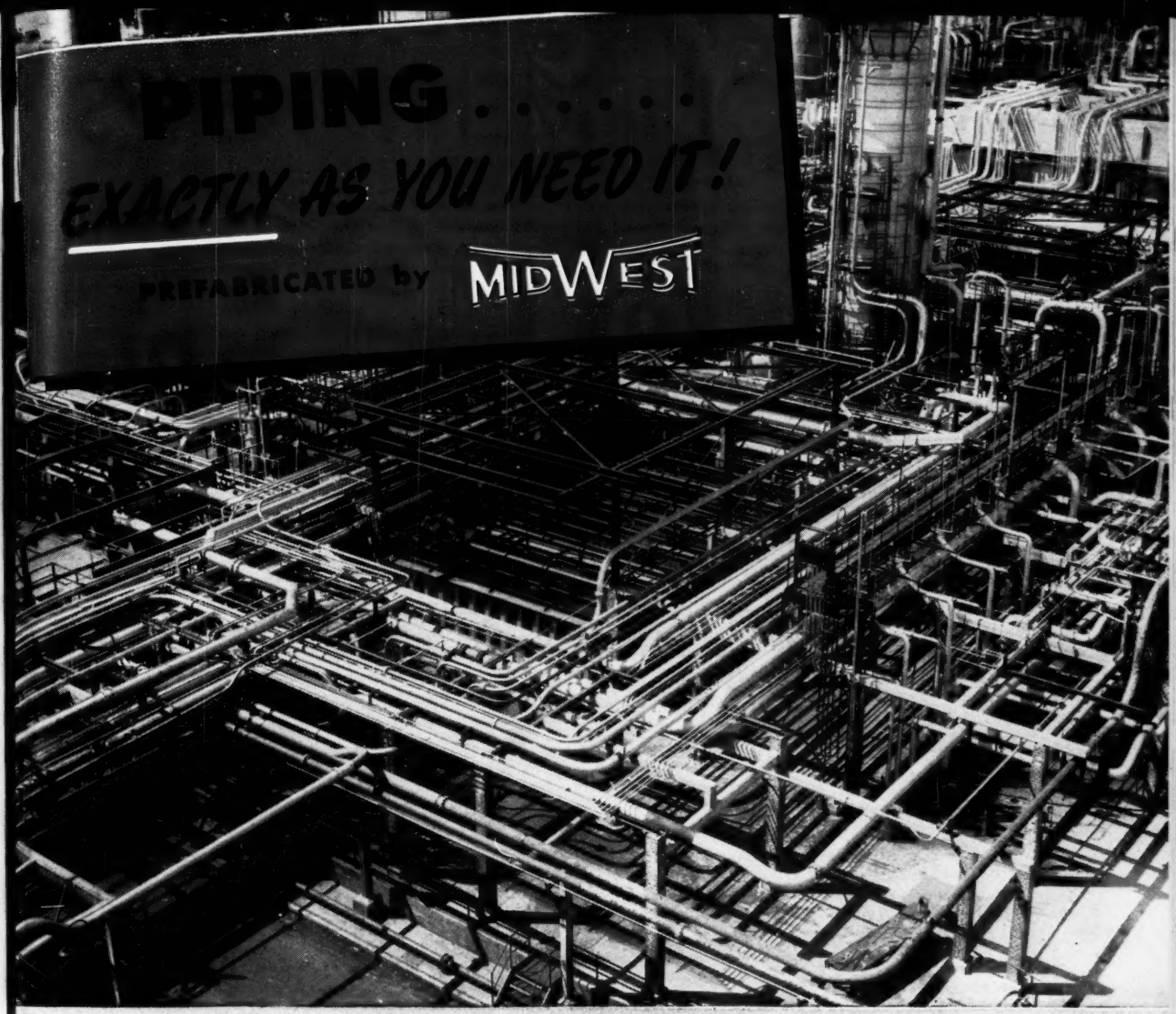

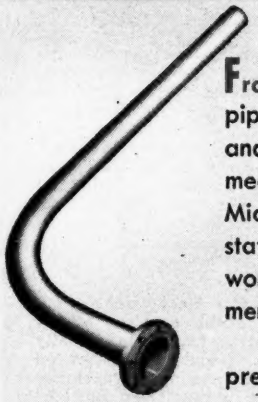

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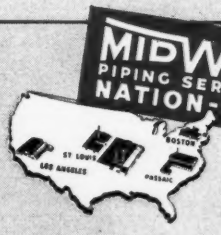

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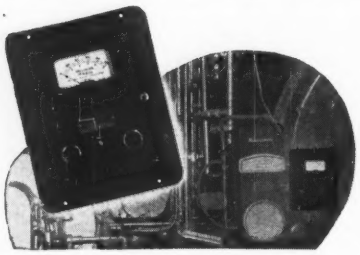
MIDWEST PIPING IS *BETTER* PIPING

NEW EQUIPMENT NEWS

Use the coupon below when you want further information on the equipment described on this page and following pages. Write the identifying letter or letters in the space provided, clip the coupon and send it to Power Generation, 53 West Jackson Boulevard, Chicago 4, Illinois

A Smoke Indicator. You can ring the bell on smoke violation, and at the same time ring the bell on loss of profits that are now going up the chimney in wasted smoke, according to this company.

Trimount Instrument Co. has just issued a bulletin which gives complete details as to how the McNeill Eclipse Smoke Indicators warn at lightning speed when smoke is going up the stack,

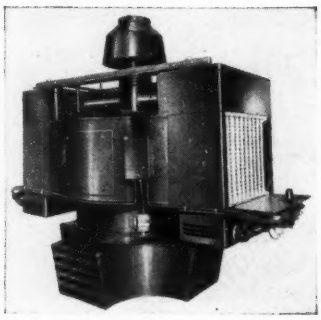


thereby insuring economic operation and compliance with the smoke laws.

This bulletin gives complete details for the extremely sensitive, accurate, and reliable operation of the electric smoke indicator. The Photo-Electric Indicating, Recording, Alarm or Periscope Smoke Indicators to suit any condition or requirement, can be supplied from stock. Trimount Instrument Co.

B Gas-Fired Unit Heater. A new, self-contained gas-fired revolving unit heater has been announced. Using either natural or manufactured gas, the heater combines gas burners, heat exchanger and combustion chamber with a motor-driven fan and revolving discharge outlets.

Designed for overhead location, it projects the heated air to the working level and by means of the revolving outlets circulates the warmth in all directions, under obstacles, into pits, and reaches into the farthermost corners.



Even in the summer these heaters are at work, but here they become a cooling device by simply turning off the gas and turning the fans on. The air is circulated in the same manner as the heated air in the winter, creating a pleasing sensation of relief from oppressive stifling heat.

The Gas-Fired Revolving Unit Heater is a ruggedly constructed piece of equipment. Heat exchanger and combustion chamber of grey iron are cast together in one piece. Extended heating surface fins on the heat exchanger are cast integral, nothing to move, or loosen. Burners are constructed of grey iron with drilled ports. Each tube of the heat exchanger has a separate burner head which permits the flame to burn in the tubes without impingement on the metal. The unit heater is approved by the American Gas Association. L. J. Wing Mfg. Co.

C Flux Meter. Model 327 Magnetic Flux Meter provides a new, simple, complete means of measuring a-c, d-c, and transit magnetic flux densities. It is said to eliminate the present errors and to use small probe for measuring fields approaching a point area and also thin enough to be readily inserted in the air gap of the average electrical machine.

Probes can be supplied in special thicknesses to suit specific measurement applications. Simplicity of operation is its outstanding feature as can be seen from the five easy steps: 1. Select desired range by means of the Range Selector Switch. 2. Set zero on Gaussometer and balance Milliampere meter to compensate for battery variation. 3. Place probe tips in Magnetic field and read Gaussometer at maximum. 4. Apply Gaussometer reading to curve of corresponding range current. 5. Find flux reading at left of curve in Kilo gauss.

Probe contains a copper Constantan

Thermocouple and for very accurate results a temperature compensating formula can be applied. Probe turned in Magnetic field indicates direction of flux maximum reading obtained when probe spirals are perpendicular to the field.

Standard range 0 to 26,000 Gauss. Special ranges available. Calibrated accuracy of 1 per cent. Connections provided for oscillographic studies of flux. Associated Research, Inc.

D Deep Burden Electromagnet. A solution to the problem of removing tramp iron from exceptionally heavy burdens of material carried on belt conveyors or passing down chutes has been found in the "Deep Burden" Suspended Rectangular Electromagnet recently developed. Claimed to be the strongest magnet known in the world, the Deep Burden Rectangular offers a means of tramp iron extraction never before available.

The magnet was developed specifically for a large southern coal mining company to remove tramp iron from coal on a 42 in. belt, 2449 ft long and delivering 1000 t of coal per hour. The depth and nature of the burden prevented placing the magnet closer than

JANUARY, 1949

POWER GENERATION
53 W. Jackson Blvd.
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It pays to standardize on Crane, the **One Source of Supply** that can simplify every piping procedure from design to erection to maintenance. **One Responsibility** for materials—brass, iron, steel or alloy—helps to get the best installations, avoids needless confusion and delay. And for dependable performance throughout piping systems, be sure that each piping item is **Highest Quality.** And that's Crane Quality—unsurpassed for more than 90 years.

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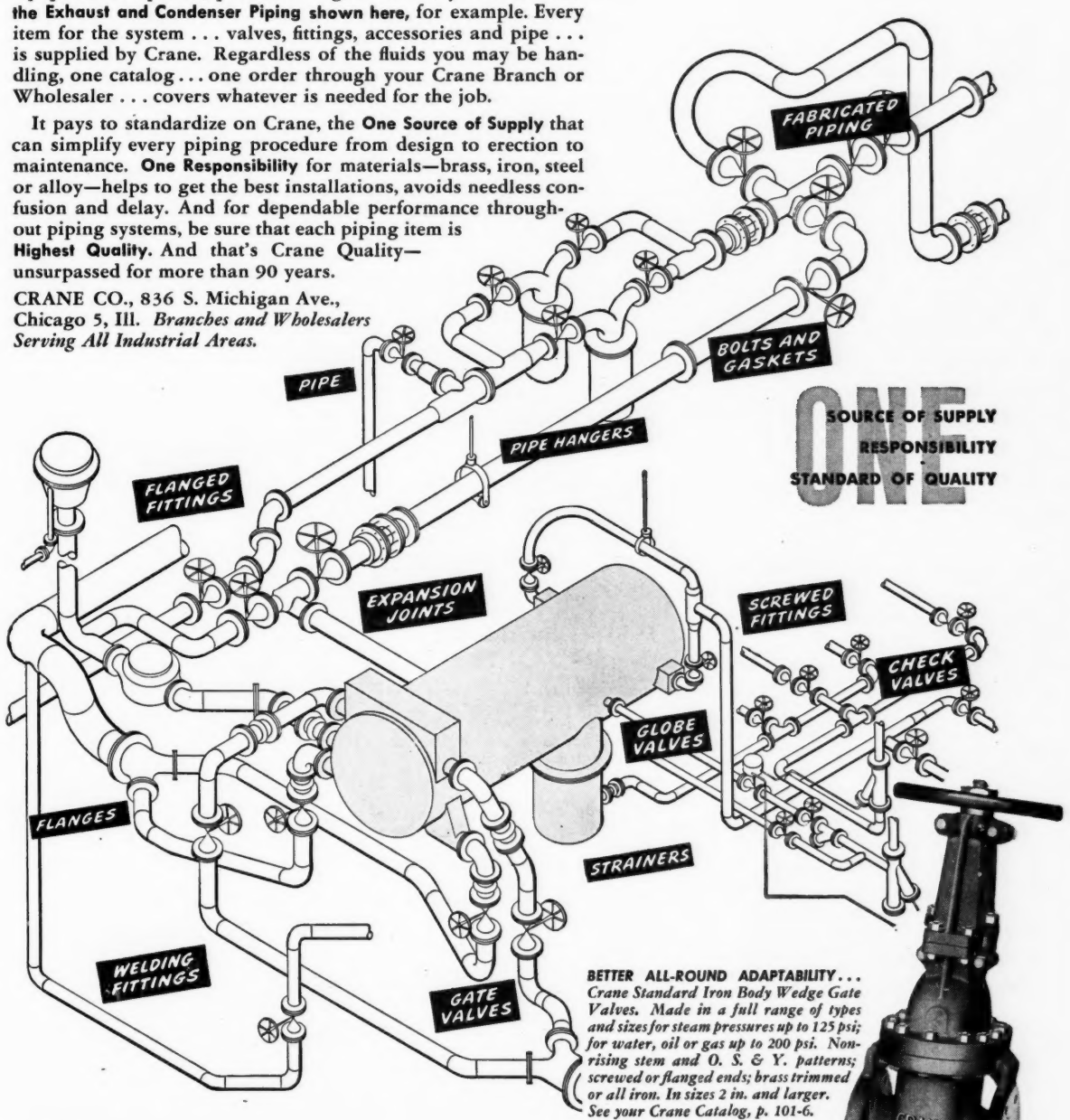

BETTER ALL-ROUND ADAPTABILITY . . . *Crane Standard Iron Body Wedge Gate Valves. Made in a full range of types and sizes for steam pressures up to 125 psi; for water, oil or gas up to 200 psi. Non-rising stem and O. S. & Y. patterns; screwed or flanged ends; brass trimmed or all iron. In sizes 2 in. and larger. See your Crane Catalog, p. 101-6.*

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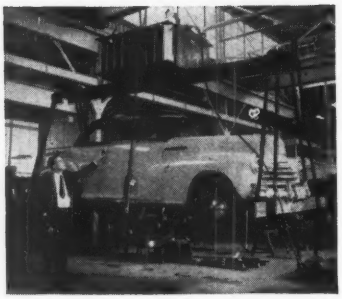


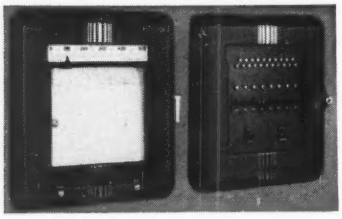
18 in. to the belt. The problem was solved by designing a triple pole rectangular magnet with an extra amount of coil windings to give the magnetic power and penetration necessary for that distance. Laboratory tests showed the intensity of the magnet field to be 200 gauss at 24 in. from the surface.

In order to dissipate the heat generated within the magnet, ribs were placed on the sides, and aluminum extensions were run internally from coil to case to assist in conduction of the heat.

The Deep Burden Rectangular Magnet can be installed suspended over conveyor belts, spouts, or chutes, and is designed for any application where heavy burdens or exceptionally fast belt speeds make it impossible for standard magnetic separators to do an effective iron-removal job. Possible uses of the deep burden magnet include protection of crushers, grinders, pulverizers, stokers and other machinery. Dings Magnetic Separator Co.

E Indicates, Records 160 Temperatures. A new instrument, called Speedomax, automatically logs as many as 160 separate thermocouple temperatures in succession at a rate of 4 sec per point. Because each point is checked at such frequent intervals, high or low temperatures which may develop can be spotted readily before serious trouble results.

In case of trouble, the operator can cut thermocouples out of the measuring sequence in banks of 20 at a time, until



the instrument is concentrated on the particular group of temperatures in which he is interested at the moment. Or, he can set the instrument to record any single thermocouple, or to record all points continuously.

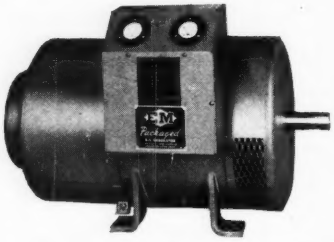
In usual operation, the instrument simply indicates while numbered lights identify each couple. Should any temperature reach a preset limit, the Speedomax automatically starts its recording chart drive, begins to record all points as a series of numbered dots, and operates an alarm.

The equipment consists of two parts, a recorder and a switch assembly—both housed in separate cases. Leeds & Northrup Co.

F Electric Insulating Tape. Bi-Seal, a new self-bonding electrical insulating tape, has just been announced. Maker states that when applied under normal wrapping tension such as in splicing electrical connections, Bi-Seal coheres to itself and other insulations to produce a permanent insulating jacket. Bi-Seal, a blend of synthetic polymers and resins, is compatible with butyl rubber, polyethylene and vinyl resins. It has outstanding dielectric strength—better than 1,000 per mil of thickness. Its aging characteristics are unusually good—no deterioration being shown after 74 hr ozone exposure. It has exceptional ozone, moisture, acid and alkali resistance—greater than any of the materials with which it is compatible.

This new tape is available in 1-lb rolls of any desired width, packed in cartons containing 48-lb net. It comes in one standard thickness, 0.020 in. Bishop Gutta Percha Co.

G Packaged Generators. New "Packaged" Generator line announced in December, 1947, featuring complete unit of generator, exciter and built-in voltage regulating circuit, is now extended to include self-contained main generator switch on ratings up to 15 kw. No additional switches or controls necessary. Unit is connected direct to load.

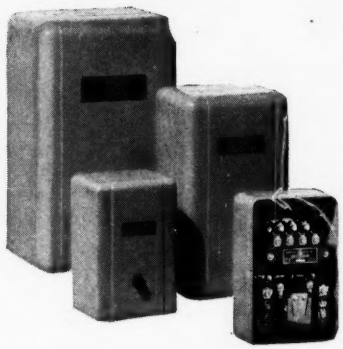


Complete modern line features units in single and 3 phase ratings up to 150 kw at speeds 900 rpm to 1800 rpm. Information available in Publication 2100-115. Electric Machinery Mfg. Co.

H Magnetic Starters. A complete new line of a-c magnetic starters is now in production it has been announced by this company's Control Division. Designed for starting and protecting motors up to 50 hp, the new full-voltage starters are furnished in all NEMA sizes from 0 through 3. The contactors can be furnished in NEMA sizes from 00 through 3.

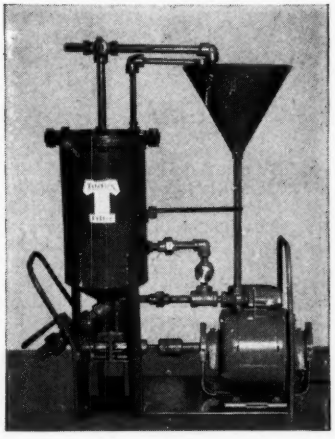
An important feature of these starters is the sturdy, one-piece plastic-encased coil enclosure which effectively protects the windings against dirt, moisture, or possible damage during installation. The clamp-type coil terminals are firmly embedded in this enclosure to prevent loosening. Self-lubricated vertical slots in the sides of this enclosure permit the magnet armature guides to move quietly and smoothly.

The silver contacts are easy to inspect, interchange, and remove without the use of special tools. Their large striking surfaces spread any wear over a broad area, thus assuring long life, and the high initial tip pressure of the contact springs practically eliminates the possibility of tip welding. In addition, an arc shield of cold-molded asbestos prevents arc-over between contacts. The silicon steel magnet is exceptionally durable and has a permanent air gap in a non-wearing surface to insure quick dropout. All steel parts are zinc plated.



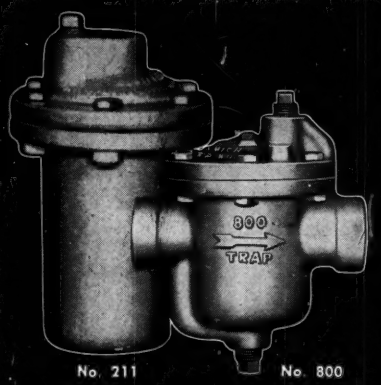
The new starters are furnished either open or mounted in general purpose, watertight, dust-tight, or hazardous atmosphere enclosures. The general purpose enclosures have rounded corners and a corrosion-resistant finish. General Electric Co.

J Portable Filter. A small, compact, portable filter has been developed for the filtration of chemical solutions with a minimum initial expenditure and no replacement cost. Known as Model L50E, it is 17 in. long by 8 in. wide by 26 in. high and weighs approximately 70 lbs. It is available in stainless steel, brass, iron, and Saran, with rubber lined tanks, and can be used on any chemical solution. This model has a small positive displacement pump rated at 275 gph and powered by ⅓ hp motor.



This unit can easily be carried from tank to tank for batch work or can filter continuously on a specific tank, is self-cleaning (does not have to be taken apart for cleaning), and requires no parts, such as bags, sheets, or pads. Model L50E has all the advantages of simplified operation, thorough and quick cleaning. Titeflex, Inc.

K Duplex Strainer. A duplex strainer has been designed to handle fluids with a high solid content without the necessity of interrupting pipe line op-



No. 211 No. 800

Above left — Armstrong bottom inlet—top outlet series trap.

Above right — Armstrong No. 800 side inlet—side outlet trap.

PROOF THAT ARMSTRONG TRAPS PAY DIVIDENDS:

50% INCREASE IN PLATING TANK COIL HEATING TIME after installing Armstrong traps on each tank. — *Proctor Electric Co., Philadelphia, Pa.*

PREFAB HOUSE OUTPUT SPEEDED UP by unit trapping with Armstrongs . . . heating time reduced over 50% . . . temperatures 10° higher. — *Riverdale Millwork Co., Chicago, Ill.*

PRODUCTION UP 20% as a result of $300 investment in Armstrong traps. — *Small sugar central in Venezuela.*

LAUNDRY INCREASES PRODUCTION 150% by unit trapping presses, tumblers, flatwork ironers and unit heaters with Armstrong traps. — *Fame-Penn Laundry, Canton, Ohio.*

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An individual Armstrong Steam Trap on every steam heated kettle, coil, press, unit heater, retort, dryer, etc. —that's the master key that unlocks the full output that was built into your equipment.

When more than one unit is drained by a single trap, unequal condensing rates and resultant unequal pressures permit blocking off of air and condensate in one or more units. Individual trapping prevents this, keeps all machines HOT all the time.

Armstrong Traps are the logical choice for unit trapping installations. They are small, compact traps with big capacity. They discharge air along with condensate, an essential to maximum temperatures. They seldom require maintenance—not stopped by ordinary dirt and scale—won't leak steam—the interior mechanism is made of materials suitable for 1000 pounds pressure, 900° F temperature.

For more details, write for the ARMSTRONG STEAM TRAP BOOK and the name of your nearby Armstrong Representative.

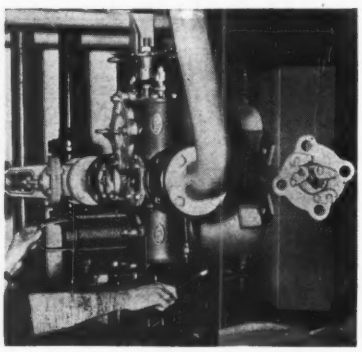
ARMSTRONG MACHINE WORKS
810 Maple St., Three Rivers, Michigan

ARMSTRONG *Inverted Bucket* STEAM TRAPS

eration to clean the strainer. These units are suitable for intermittent as well as continuous flow. Their flexibility of design permits the handling of sudden surges of solids.

Flow through the unit is diverted from one straining chamber to another by a large, easily operated handwheel without the possibility of any positive shut-off. While flow passes through one straining chamber, the other may be cleaned. Covers are removable for lifting out the perforated strainer baskets.

This strainer is adapted to high open area ratio and is suitable for a wide



range of pressures and temperatures. Valve seats are removable and valve stems are supported at both ends for accurate permanent alignment. A large handhole above each valve assembly permits servicing the valves without removing the strainer from the line.

The strainer basket is set eccentrically, with respect to the basket chamber so that the flow section is proportional to the flow needs at all points, thus minimizing pressure drop. Available in bronze, steel, semi-steel and cast iron, with strainer baskets made to specification in perforated brass, monel, or other metals depending upon the service conditions. Mesh or magnetic types are also furnished to specifications. J. A. Zurn Mfg. Co.

L Combination Meter. A new single-phase combination watthour and thermal watt demand meter for industrial use has been announced. Designated as the Type IHM-1, the new meter is housed in a case slightly larger than that required by a conventional watthour meter. It can be installed wherever rate structures require the determination of demand as well as

energy, without increasing the size of the original installation.

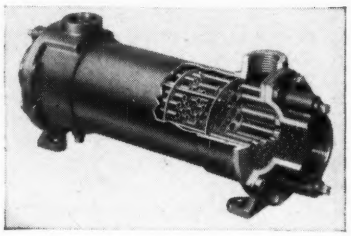
The revolutionary new damping system and electromagnet of the recently introduced I-50 watthour meter, adapted to the new design, comprise the watthour unit of the Type IHM-1 meter. The thermal unit of the Type HI-1 thermal meter with its "direct heat" operating principle has been adapted for use as the thermal demand unit of the new combination watthour and thermal watt demand meter. General Electric Co.

M Heat Exchangers. An extensively redesigned line of mass produced, standardized heat exchangers is announced at lower unit cost and with constant availability from stock.

The new type "BCF" exchanger is the product of many years of development based on the service records of 150,000 similar units. This research has enabled the manufacturer to determine the design features, sizes and capacities in greatest demand, to standardize them and place them into mass production.

For diesels, gas engines, compressors, hydraulic machinery, blowers and many other industrial applications the manufacturer claims to have achieved the lowest cost per btu transferred.

The favorable low cost—high performance ratio will be of interest also to the equipment dealer stocking heat transfer equipment for resale and to the



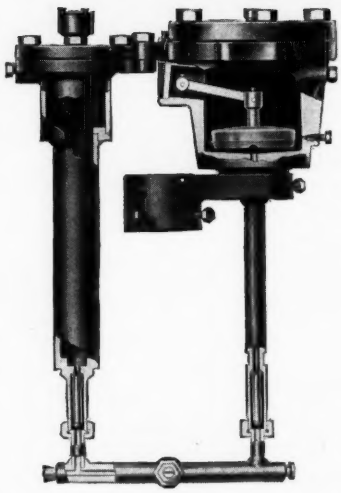
ultimate industrial consumer who is facing inflated operating costs while suffering from slow deliveries. The new "BCF" is the first shell and tube exchanger to be carried in stock as shelf goods.

While the "BCF," from its wide use in jacket water and lube oil cooling, has long been referred to as a cooler, it is also a heat exchanger in the true sense of the word. It is said to be equally effective in heat recovery, vapor condensing and process heating applications. Ross Heater & Mfg. Co.

N Mercury Manometer. A new type of mercury manometer has been designed and built to meet industry's requirements of positive actuation, dependable performance and greater adaptability in flow, liquid level and differential pressure measurement. The new manometer is designated as Model 1500 to signify its 1500 psi working pressure and is available in ranges of 10 to 400 in. of water. It is built for use on indicating, recording or controlling instruments and two manometers can be mounted on a single case for recording two flows or ratio flow control.

A few of its outstanding features include: (1) Greater energy output which is made possible by the use of a large diameter float and long float travel.

(2) Specially designed Pressure Tight



Bearing of stainless steel with Teflon bearing surfaces . . . the new synthetic plastic whose self-lubricating characteristic assures no freezing, reduces friction to a minimum and gives leak-proof performance.

(3) Positive Overrange Protection is provided with positive-acting, non-sticking check valves submerged in mercury. These valves give protection against loss of mercury from overrange, sudden fluctuations and flow reversal.

(4) Leakless damping adjustment under full-rated pressure is assured with an uniquely designed damping device.

(5) Interchangeable range chambers contribute greatly to the adaptability of the new manometer which now gives continuous ranges from 10 to 533 in. of water. No piping changes are necessary when changing from one range to another.

Straight-line calibration is an inherent feature of the new Mercury Manometer. Accurate measurement of differentials is assured at every point on the chart, either up-scale or down-scale. Through careful selection of materials, skillful designing and precision workmanship, differential readings can be reproduced with practically zero error. Taylor Instrument Companies.

O Mercury Relays. A new line of improved and perfected "hydrogen arc-quenched" mercury type relays. These relays operate on the "double flow" principle. Contacts are between two pools of mercury, in the presence of hydrogen gas under high pressure, keeping arcing at a minimum. Heat and corrosion, the manufacturer states, are virtually eliminated.

Notable characteristics of the new relays include four types of action. These actions, available with normally open or normally closed contacts, are described as (1) Quick Operate-Quick Release, (2) Quick Operate-Slow Release, (3) Slow Operate-Slow Release and (4) Slow Operate-Quick Release. Time delays are available to specifications from 0.15 second to 20 seconds.

The relays are made in single or multiple units. Single units are furnished in 2 sizes, 30 or 60 amps. The relays are suitable for the switching of heavy loads in practically all fields, including highly inductive circuits such

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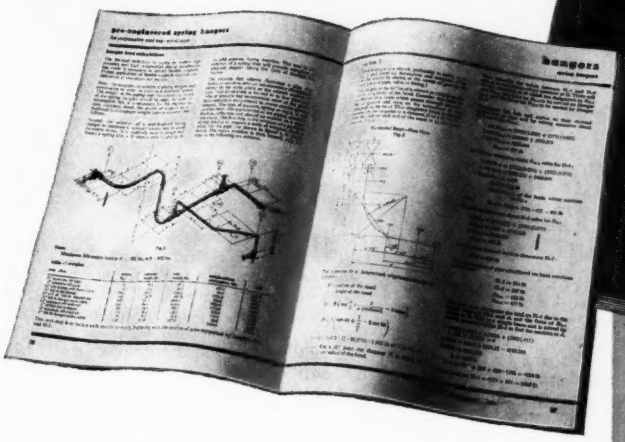
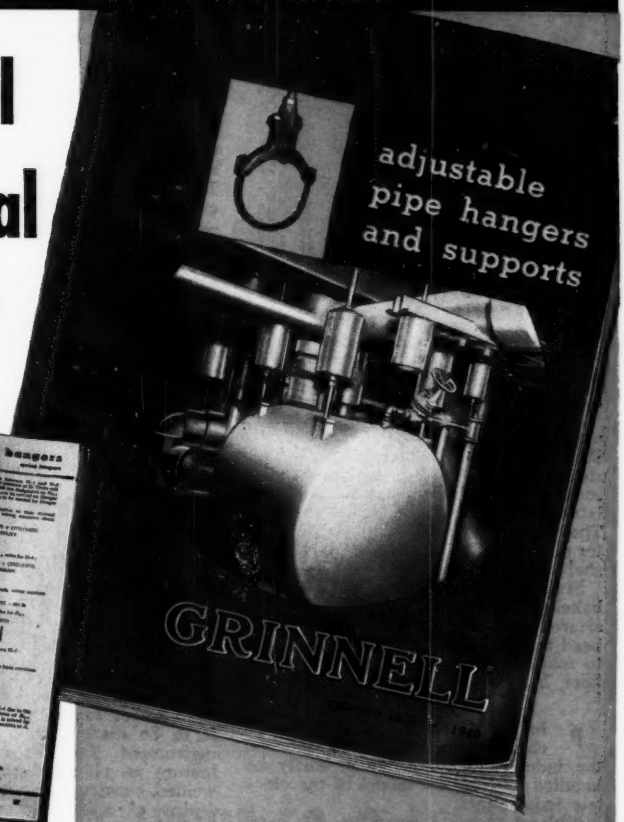
. . . and comprehensive catalog 10-D





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- ★ How to make load calculations for spring hangers, step by step, with drawings
- ★ Constant support or variable spring hangers may be selected and specified from simple load tables
- ★ Method of calculating take-out and determining hanger rod lengths . . . schematic drawings and formulas
- ★ Standard specifications with tables of maximum spacing between pipe supports, load carrying capacity of steel hanger rod, also rod size as determined by pipe size for fire protection work
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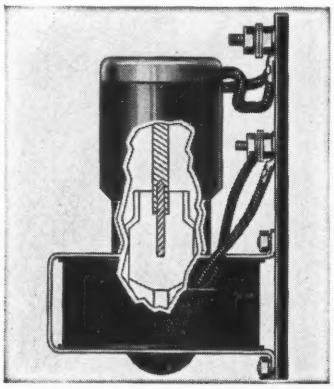


as solenoids and motors. Extensive tests indicate many millions of contacts are to be expected.

Another new feature is found in the method of sealing the hydrogen gas into the relay. The body is steel. This steel is welded in a pressure chamber so that the hydrogen gas in the relay is welded in at about 60 lbs. pressure. There is no noticeable deterioration after many months of lying on stock room shelves—or on inactive machines.

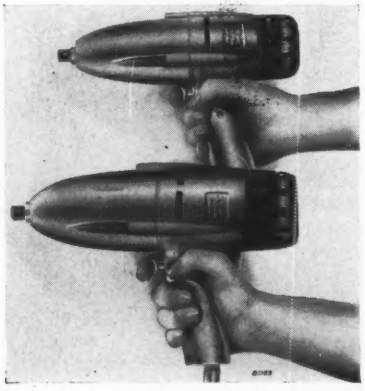
Standard construction calls for a bakelite insulating shell which is considered moisture proof—but the end bead may be rubber covered if desired to make the relay waterproof. Durakool, Inc.

P Impact Tool. Those heavy machinery maintenance jobs in the industrial field can now easily be handled with a new model of the electric impact tool.

With standard accessories, the new model is rated to run and remove nuts up to ⅝ in. thread size; drive and remove studs; extract broken cap screws and studs; apply and remove machine screws of all kinds; run wire brushes; drill brick, metal, and masonry; tap; and ream. It may also be used for woodboring.

Known as the 8U, the tool may be used for such heavy jobs as removing covers from machines, tightening or loosening nuts on large pipe collars and elsewhere, and for general all-purpose maintenance work around machine shops.

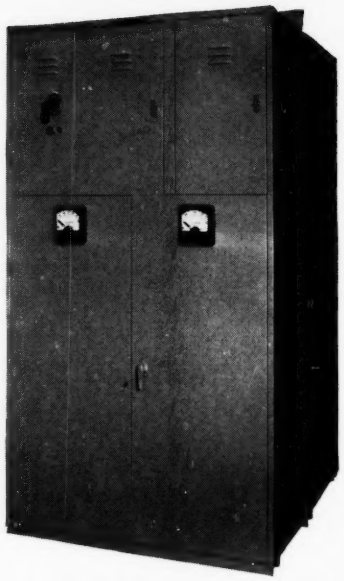
It has all the features and advantages that have made the 4U model so useful for light maintenance and production work. The reversible motor makes it as easy to remove screws, studs, and nuts as to apply them; the motor never burns out—even if the spindle stalls; the impact principle operates whenever resistance is met and provides extra power to push through the job. Virtually no torque reaction is transmitted back to the operator.



The new tool is 12⅛ in. in length and weighs 9 lb, 13 oz. It is available for either 110 or 220 v current and operates on ac or dc. The following operations may be performed with standard accessories: Apply and Remove Nuts—The unit is rated to handle nuts and cap screws up to ⅝ in. thread size. Drill—Rated for ⅜ in. drilling in metal—up to ¾ in. by step drilling; Ream—Reams up to $1\frac{1}{16}$ in. diameter; Tap—Taps from ⅜ in. to ¾ in.; Drive and Remove Screws—All types of machine screws up to ⅝ in. thread size and wood screws up to size No. 22; Drive and Remove Studs—Capacity up to ⅝ in. thread size; Extract Broken Cap Screws and Studs—Up to ⅝ in. thread size; Run Wire Brushes—Various types of wire brushes with round shanks up to ½ in. diameter; Woodboring—Up to ⅝ in. twist drills with collet-type chuck; up to 1¼ in. with Morse taper; Drill Brick and Masonry—Carbide-tipped drills up to ⅝ in. diameter. Ingersoll-Rand Co.

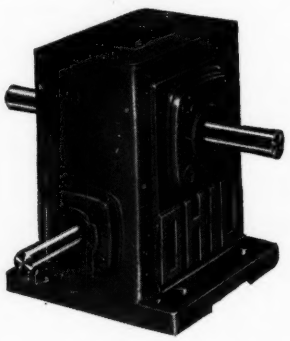
Q Temperature, Pressure Recorders. Announced is a new line of gas-filled temperature recorders and recording pressure gages. These recorders are available with 1, 2, 3 or 4 pens and provide for easy field installation of the actuating system and pen mechanism if, for example, a 1-pen recorder is to be made into a 2, 3 or 4 pen instrument. Temperature tube systems feature an all stainless steel, Heli-arc welded construction with an improved design of spiral spring. A standard bulb design is arranged so that it can be converted in the field into any of the usual apparatus connections: union flange or hub with bendable extension, union flange or hub with rigid extension, union with separable socket with or without extension neck, adjustable connection with split flange. All recorders are covered by a 2-year guarantee. Penn Industrial Instrument Corp.

R Circuit Breakers. A new line of low-voltage controllers for use with a-c motors up to 806 hp (at 550 v) and for d-c motors up to 350 hp (at 230 v), has been announced. These new metal-enclosed controllers are designed for controlling squirrel-cage, wound-rotor, synchronous, or multi-speed a-c motors, or d-c motors. Common applications for which they are desirable are pumps, mixers, grinders, mills, and similar drives in the heavy industries. The new controllers are unusual in that they include in one unit not only the conventional equipment required to start, stop, and control such motors, but in addition include a completely integrated draw-out air circuit breaker which provides adequate short-circuit protection (either 25,000 or 50,000 amp). Serving also as a circuit isolating device, this draw-out air circuit breaker is designed so that it is readily interchangeable. Therefore, when one is removed for servicing another may be substituted immediately, thus preventing lengthy production delays. In addition, when the breaker is pulled out to the inspection and test position,



it is mechanically latched and disconnected from all power. A mechanical interlock trips the breaker when it is removed from its unit. Mechanical interlocks also prevent closure of the breaker unless it is either in the operating for inspection and test position. The dead-front metal enclosures housing these controllers are 90 in. high and can be easily lined-up with other control and switchgear equipment, or placed beside the machine. Factory-assembled, the only electrical connections required are incoming and outgoing leads. Easy inspection is facilitated by hinged doors, front and back, equipped with automobile-type handles. General Electric Co., Control Dept.

S Speed Reducer. A new single reduction speed reducer in the "baby" size is announced. The new unit, designated as BHS, is a right angle drive with input shaft below and the worm gear or output shaft above. Overall dimensions are: 4¾ in. long, 3 in. wide, and 6¼ in. high. Ratios available range from 6-1 to 58-1, input horse-



power is from ⅛ to ⅝ and output torque (1800 rpm input) ranges from 103 in. lb to 168 in. lb, depending on ratio. Input shaft diameter is ½ in. with 1⅝ in. extension; output shaft diameter is ⅝ in. with $1\frac{15}{16}$ in. extension. Housing is of aluminum alloy. Base is 5 in. wide and 4¾ in. long. Bolt hole centers are 2⅞ in. in length by 4⅛ in.

Read the big news about J-M's new Ramie Fiber packing!

NAVALON reduces shaft wear to a minimum because it is abrasive-free.

NAVALON IS BIG NEWS for you . . . because it is a new, long-lasting packing, developed by Johns-Manville especially for cold liquid service.

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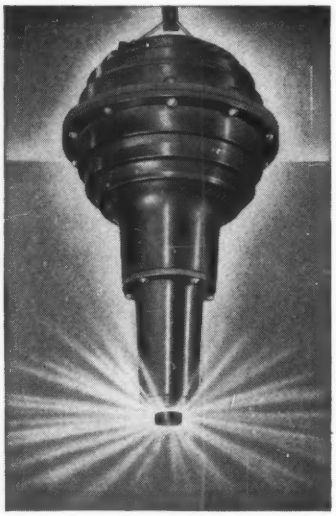
Johns-Manville PACKINGS & GASKETS

in width. Worm is of high grade carborized steel selected for its exceptional wearing qualities. The worm gear is made of special nickel bronze selected for maximum strength balanced with a minimum coefficient of friction. Ohio Gear Co.

T Fire Control. A fire guard that stays on duty 24 hr a day—that goes into action as soon as fire starts, creating a dense fire-smothering cloud which spreads over an average size room—that, in brief, is Aut-O-Jet, a new type of completely automatic fire control unit.

At 160 deg, Aut-O-Jet automatically goes into action, filling the enclosed area it guards with a piercing spray which quickly turns into a thick, fire-suffocating cloud. Aut-O-Jet, approximately 12 in. long and 6 in. wide, is installed overhead, so that the cloud it forms can settle down to extinguish the fire below. Spray is ejected under pressure covering a radius of 10 to 15 ft from the unit. It will last as long ordinarily as the house or other structure it safeguards. Die-cast aluminum encloses a glass reservoir containing a quart of carbon tetrachloride, which



cannot leak or evaporate because its container is hermetically sealed. All vital parts of the unit are protected from moisture and dust. Aut-O-Jet is recommended for homes, factories, barns, ships or any other enclosed structures. Aut-O-Jet Co.

U Improved Switch Engines. Improvements in standard model 65 and 80 ton switching locomotives are announced. The changes in the diesel-electric units give increased power and improved continuous tractive effort ratings. The new locomotives are each equipped with two super-charged diesel engines with a maximum rating of 275 hp at 2100 rpm, or a total of 550 hp per locomotive. This is an increase of 38 per cent for the 65 tonner and 10 per cent for the larger model. The power actually delivered to the generators for traction is 420 hp. This compares with 330 hp in the old model 65 ton unit, and 440 hp on the old 80 ton locomotive.

Maximum tractive effort has not been changed because there has been no change in the weight of the units. However, the continuous tractive effort ratings have been improved. The No. 747 motor with which the new locomotives are equipped is a self-ventilating, double reduction motor that replaces the non-ventilated reduction motors used in the old models. The improved capacity of the No. 747 means that a certain tractive effort can be maintained for a longer period of time.

The No. 747 rates 5200 lb tractive effort on a continuous basis. This is equal to 16 per cent adhesion on the 65 ton and 11.5 per cent on the 80 ton unit. The one-hour rating is 6200 lb, equivalent to 19 per cent adhesion on the 65 ton and 13.8 per cent on the 80 ton. These high ratings enlarge the field of application and makes it possible for them to handle the heavy jobs without blower equipment being added.

Other improvements on the new models are clasp-type brakes and Pullman steps on the 65 ton hinged windows in front of the operating station; and a full metallic circuit with ground relay to provide a degree of protection from damage due to accidental grounding. General Electric Co.

V Sample Cooler. A new compact unit for continuous sampling of low-pressure steam is announced. Consisting of a copper coil within a copper shell, the model SC-9 sample cooler, rated to condense and cool 125 psi, saturated steam, runs the cooled sample through a throttling valve, past a thermometer and then through a small flow type conductivity cell, and to waste. A wide variety of solu-bridge recorders for steam purity measurements are adapted for use with the new sample cooler. Steam sample inlet and cooling water connections are respectively ⅛ and ⅜ in I.P.S. Overall dimensions are 18 by 4½ in. Industrial Instruments, Inc.

W Wiring Test Set. This wiring inspector's test set has been developed to enable one person to make a complete test of the wiring in any building without additional help. The device is housed in a gray fiber carrying case measuring 14⅞ by 7⅞ by 9⅛ in. high. Total weight is 13 lb. A compartment provides storage space for the flexible leads and the portable meter. Power is supplied from a standard 6 v dry cell, which can be easily replaced. All standard electrical component parts are used throughout. Eastern Specialty Co.

Y Self-Locking Plier. A 8 in. side wire cutter is claimed to feature a double compound eccentric cam action that gives considerable cutting power. The plier locks by normal hand pressure and holds, leaving both hands free to work. It is made of drop-forged chrome vanadium steel. Price is $4.50. Ross Mfg. Co.

X Insulating Bushing. A new, insulating bushing for electrical wiring systems has been announced. It is precision molded to close tolerances and is reinforced to give maximum dielectric and mechanical strength.

The manufacturer believes that the low price of the new bushings will encourage maintenance men to insulate every conduit terminal in order to minimize electrical "grounds," which are potential causes of short circuits.

These molded bushings can be used with insulating covers. They meet all code requirements, and are available in a complete range of sizes. The company will continue to produce the familiar line of Sali insulating bushings, which are machined from laminated phenolic material and were the first insulating bushings to gain widespread acceptance. Adalet Manufacturing Co.

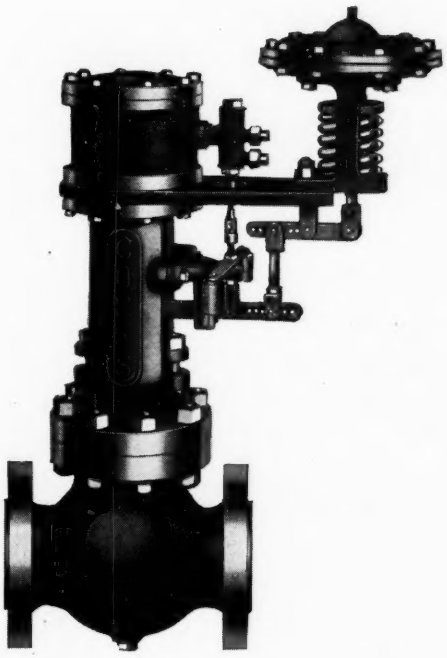
Z Electric Drill. A completely new 7 lb portable electric half-inch Silver Line drill is announced. The new drill is designed for continuous, stall-free drilling through toughest metals, with power unequalled in its weight class. Powerful ventilation through large slotted ports keeps the heavy-duty motor constantly cool under heavy load.

This new drill has a highly polished, mirror-like die casting case, a free speed of 500 rpm, full ball-bearing construction, removable dead handle, steel bearing inserts, removable switch handle for simple service, precision gearing, 3-jaw Jacobs key type chuck. The drill's length is 11 in. Independent Pneumatic Tool Co.

AA Soldering Flux. This new liquid aluminum soldering flux makes possible sweating on aluminum, stainless steel, monel, copper, brass, steel or any combinations of these metals. This flux breaks the surface oxide on all types of aluminum so that a sweat job is possible. When used in combination with this company's All Metal Solder it is said to eliminate the electrolytic action between dissimilar metals so that a permanent bond, highly resistant to corrosion is obtained. Induction heaters as well as torch or iron can be used for heating mediums. This flux is $3.50 per pound. Farrelloy Company.

For more exacting

PRESSURE REDUCING JOBS



Type R-DSLH, relay-operated for remote control
Below: Type DBI is direct-operated and self-contained

COPES Pressure Reducing Valves are designed for tough jobs demanding greater accuracy and dependability than can be obtained with ordinary stock valves. They are built to give as good results under emergency conditions as in normal service—to avoid objectionable vibration, noise and wear. Each is engineered for the individual installation, to assure close pressure control and long service life with minimum maintenance.

The COPES line is complete, covering a controlled pressure range from 27 inches of mercury vacuum to 600 psig. Valves are direct- or relay-operated, self-contained or actuated by a master control—as dictated by the individual operating conditions. Write for Bulletin 477.

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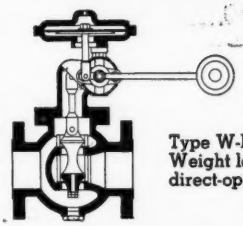
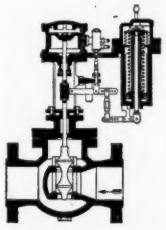
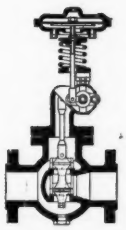
NORTHERN EQUIPMENT COMPANY
192 GROVE DRIVE, ERIE, PA.
BRANCH PLANTS: Canada, England, France and Austria
Representatives Everywhere



Type W-DBI. Weight loaded, direct-operated



Type 3-SH-2C for heavy duty. Relay-operated, self-contained



Type R-DBI for remote control from master

COPES

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Boiler Feed Water Control . . . Excess or Constant Pressure Control, Steam or Water . . . Liquid Level Control . . . Balanced Valves . . . Desuperheaters . . . Boiler Steam Temperature Control . . . Hi-Low Water Alarms.

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EXPANSION JOINTS
Reduce Steam Line Maintenance

Steam line maintenance is simplicity itself when Yarway Gun-Pakt Expansion Joints are on the job.

There's no need for costly shutdowns and heating interruptions to service joints. *It's all done under full steam pressure.* Insert a plug of packing, turn a wrench, the joint's tight.

Maintenance costs are exceptionally low. For example, one utility spends 65 cents per year per joint . . . another less than half that.

Whatever your expansion joint needs may be, investigate GUN-PAKTS. They will save you money.

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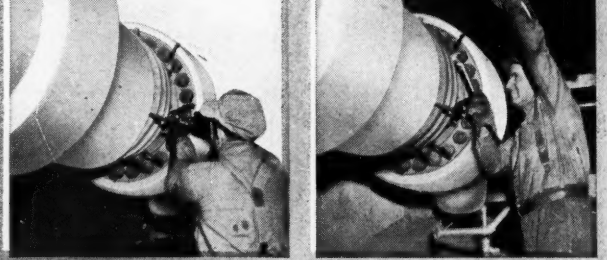
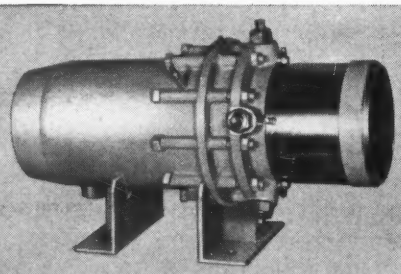
UNDER FULL STEAM PRESSURE



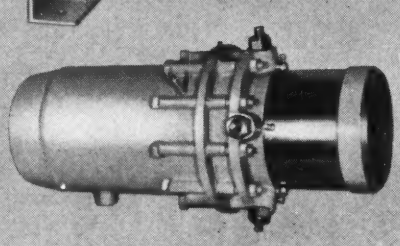
1. INSERT YARWAY PACKING. **2. TURN A WRENCH.**

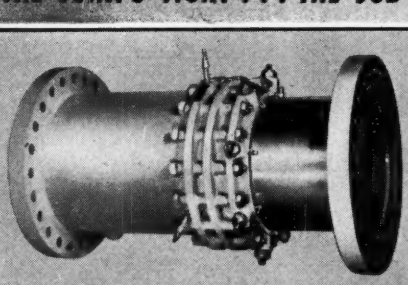
THE JOINT'S TIGHT . . . THE JOB DONE



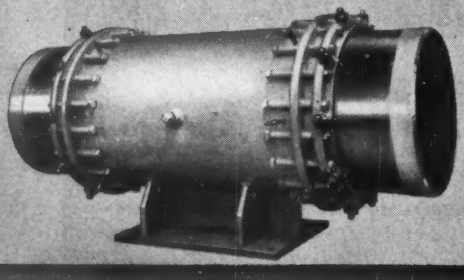
SINGLE END WELDING TYPE with base 150 lbs. pressure

SINGLE END WELDING TYPE without base 150 lbs. pressure



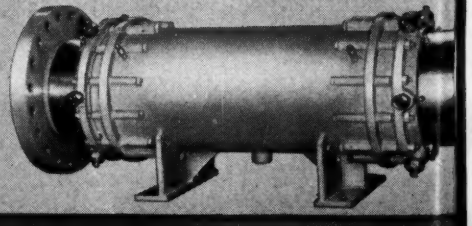


SINGLE E FLANGED T without b 400 lbs. pre



DOUBLE END WELDING TYPE 150 lbs. pressure

DOUBLE END FLANGED TYPE 300 lbs. pressure



YARWAY GUN-PAKT EXPANSION JOINT

POWER GENERATION

Present and Future

IN THE PAGES that follow we review briefly the trend of power developments during the year 1948 and present the outstanding features of our most modern power plants. It is an amazing and wonderful thing, this power industry—the hundred thousand kilowatt generating units, the 1600 lb pressure, 1050 degree boilers; the two hundred thousand volt transmission lines, the far flung system of interconnections. To one not versed in these matters, a visit to a modern steam-electric generating station is a bewildering, almost awesome, experience. It seems incredible that man could have done all this. We have come a long way from Pearl Street to Sewaren.

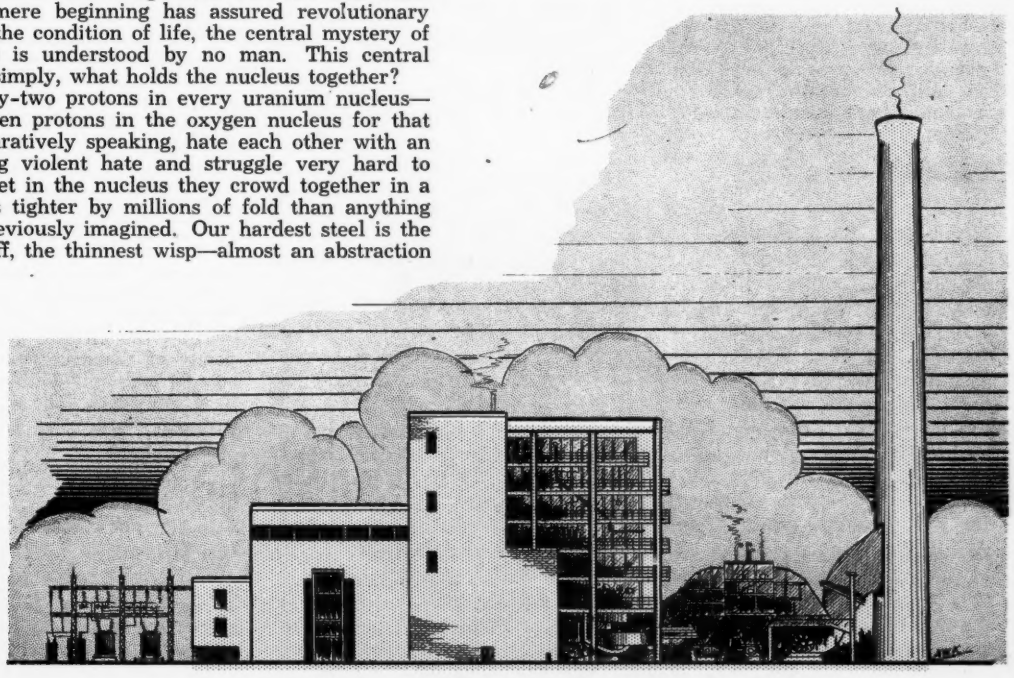
Yet we have only scratched the surface in our development of power. All this vast thing we call the power industry—all these magnificent generating stations, all these thousands of miles of transmission lines, all the great manufacturing plants which support and are supported by the power systems, utilize only the barest crumbs of energy of the atom. In all this great system of power production we use only the feeble tremblings of a few tiny electrons whirling in the outermost orbits of the atoms. Only in the last few years have we learned something about the infinitely greater forces residing in the mysterious center of the atom, the nucleus. It is there, in the nucleus of the atom, not in new petroleum reserves or in new coal deposits or further water power development, that we must look for the power of the future.

So far, we have learned only to split one certain kind of nucleus in a continuing chain reaction and while even that mere beginning has assured revolutionary changes in the condition of life, the central mystery of the nucleus is understood by no man. This central mystery is simply, what holds the nucleus together?

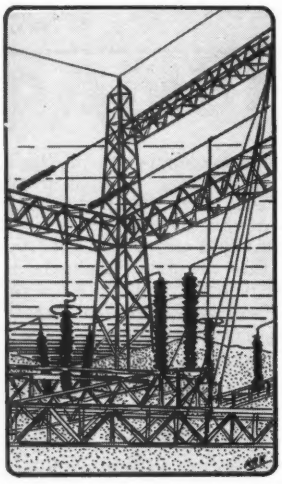
The ninety-two protons in every uranium nucleus—or the sixteen protons in the oxygen nucleus for that matter—figuratively speaking, hate each other with an unconsuming violent hate and struggle very hard to separate. Yet in the nucleus they crowd together in a compactness tighter by millions of fold than anything man has previously imagined. Our hardest steel is the sheerest fluff, the thinnest wisp—almost an abstraction of empty space when we compare it with the incredible solidity of any atomic nucleus. What is the force, the fantastically stupendous force, that makes this happen? What is the "glue" of the nucleus?

It is in the analysis and ultimately the synthesis of this nuclear "glue" that the power industry must look for its future source of energy. Until such time as we discover this secret we will go on building Sewarens, Hutchingses, Sporns, Port Washingtons and other great fuel-fired stations, but there is a limit to our progress in the design of conventional fuel fired plants. We may be impressed by the magnificent complexity of these modern stations but, remember, we are nearing the ultimate theoretical limit of efficiency of the steam cycle.

At Sewaren, with its 1050 degree temperature, the steam pipes, the throttle valves and steam chests will run a dull red. Previously, turbines have operated at 1000 degrees but it is the last 50 degrees that makes the job tougher, and from now on, we will have to weigh even more carefully than before the value of any further increase in temperature against the gains. Each 50 degree temperature increase reduces the coal consumption by 1.4 per cent and in the future the utility industry may find it more profitable to spend money in developing other methods of producing power. As Chancellor Robert Hutchins of the University of Chicago pointed out recently, any large industrial concern that hopes to be in business 25 years from now should be thinking and doing something about atomic energy now.—A.W.K.



ELECTRIC POWER DEVELOPMENT IN



IMMEDIATELY following the close of the war in 1945 campaigns were started in the electrical industry to promote load building programs to provide load for the *excess* capacity that was expected to result as the war industries shut down. These load building programs were scarcely started when it became evident that the industry was being overwhelmed by the greatest demand for electric power it ever experienced. Instead of having to provide load for the *excess* capacity the utilities found themselves with such narrow margins of reserve capacity over load demands that it was not even funny. The realization of the deluge that was upon the industry started the present race with time to keep the generation, transmission and distribution facilities abreast of the continually growing load. By the end of 1947, the total electrical load was over 49 million kw while the installed capacity was a scant 52 million kw. On a national scale this was a reserve of only 3 million kw but in many localities there was no reserve at all.

As a consequence of this situation, the utilities have been stretching their expansion programs to the utmost and during 1948 an additional almost four million kilowatts were installed. The load, however, continues to increase, and failure to meet the growing demand in certain areas made it necessary, during the year, to discourage load growth in an effort to maintain service until such time as building facilities can keep pace with load demand. As reported in our review of 1947, during 1948 also, it became necessary in certain areas to resort to voltage reduction.

The end of the year 1948 saw the utilities with a total installed generating capacity of 55 million kilowatts. According to statistics released by the Electric Light & Power Companies, the 4 million kilowatts of capacity installed in 1948 will be exceeded in 1949, since 5,302,000 kw is scheduled for installation this year. The complete statistics are as follows:

NEW ELECTRIC CAPACITY

Installed in 1947	1,538,000 kw
Installed in 1948	4,800,000 kw
Scheduled for 1949	5,302,000 kw
Scheduled for 1950	4,707,000 kw
Scheduled for 1951	5,217,000 kw

This is the amount of generating capacity actually projected by the utilities, total of 15,226,000 kw during the next three years. Careful studies of the various factors involved in the load growth indicate that during the next eight years we will have to add some 40 million kw of new capacity. Fig. 3 prepared by the Market Development Dept. of Westinghouse indicates an installed capacity of some 95 million kw in 1957. This curve (The vertical scale is logarithmic) shows the narrowing margin between installed and reserve capacity. Taking the period between 1947 and 1957, this study indicates an annual average increase of 4.3 million kw without provision for increased replacement needs. It must be remembered that approximately half of the present 55 million kw of installed capacity is twenty years old. Much of this old equipment will have to be replaced sooner or later.

Thus, the electric generating capacity of the country will have to be approximately doubled during the next ten years. The 95 million kw installed capacity in 1957 will provide a reserve of about 15 per cent which, although considerably below prewar margins, is estimated adequate in a larger well-integrated system with a more even distribution of load.

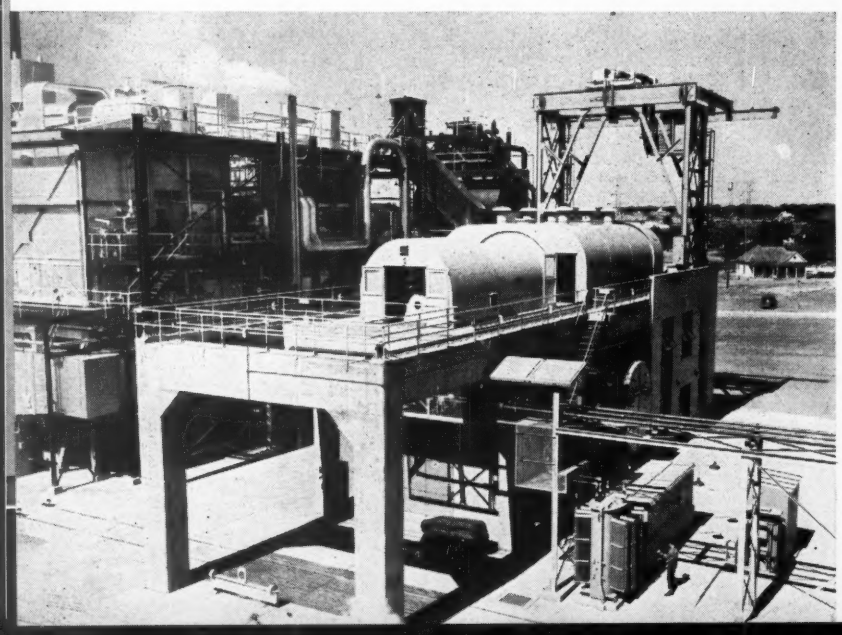


Fig. 1. Handley Steam Electric Station of the Texas Electric Service Company. This 42,900 kw installation is an excellent example of modern outdoor type of construction

IN THE U.S. IN 1948

On the whole, considering the shortage of equipment and the depleting effect of the war years, the utilities have done an excellent job in meeting the load demands. The Edison Electric Institute committee's latest report indicates an approximate margin of 4 per cent between the peak and the installed capacity for 1948. This is slightly less than it was a year ago despite the 4,800,000

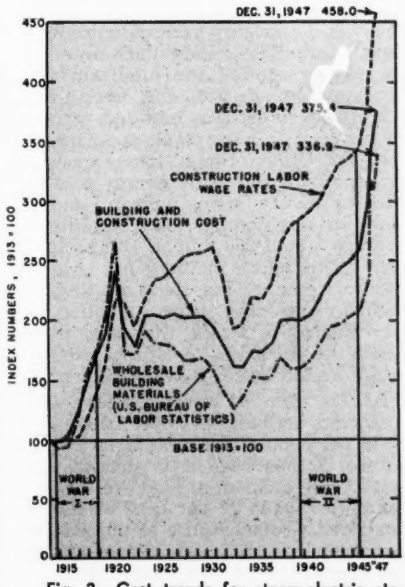


Fig. 2. Cost trends for steam-electric stations. From "The Upward Trend of Construction Costs" by F. C. Gardner, v.p. Ebasco Services, Inc.

kw installed during the year. Detailed studies indicate that the picture for the next year appears considerably better and from then on the margin should materially increase. As already mentioned, by 1957 the reserve should be in the neighborhood of 15 per cent.

One of the vital factors which has retarded the more rapid expansion of electric generating capacity has been the inability of the manufacturers of large power plant equipment to turn out their products at

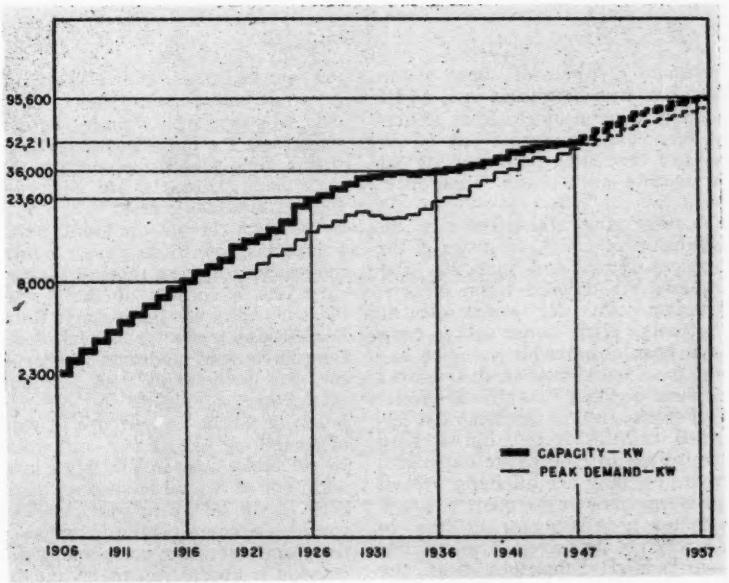


Fig. 3. Capacity vs peak demand. From The Electrical Industry by 1957, published by Westinghouse Electric Corp.

a fast enough rate. This has been particularly true of turbine generator manufacturers. There are only three firms in this country capable of turning out large turbine generators and although these firms—General Electric, Westinghouse and Allis Chalmers—have stretched their facilities to the utmost they have not been able to meet the terrific demand. This situation, however, is easing somewhat and manufacturers are improving their position. In the case of General Electric, for example, its production of large turbine generators for the electric utilities during 1948 exceeded the production of any previous year by more than 1,000,000 kw. In all, 65 units with a total generating capacity of 2,932,000 kw—an average of about 45,000 kw per unit—were produced in the Schenectady plant.

The situation with respect to large boilers has been similar though not quite so serious as for turbine generators, and some of the smaller boiler manufacturers could use more business.

Power generating capacity in industrial plants has not increased as rapidly as in utility plants. The total industrial generating capacity, including the railroad and railway plants was 13,037,147 kw on September 30, 1948. This compared with 12,798,525 kw on the corresponding date a year before, an increase of 238,622 kw or slightly less than 2 per cent.

The tight situation in the utility industry with respect to generating capacity may have some effect in stimulating the increase in industrial power plant capacity. In a number of localities, the utilities have discouraged the sale of power and that together with reduced voltage and, in some instances, frequent interruptions in service have caused some industrial concerns to consider the installation of power plants. Un-

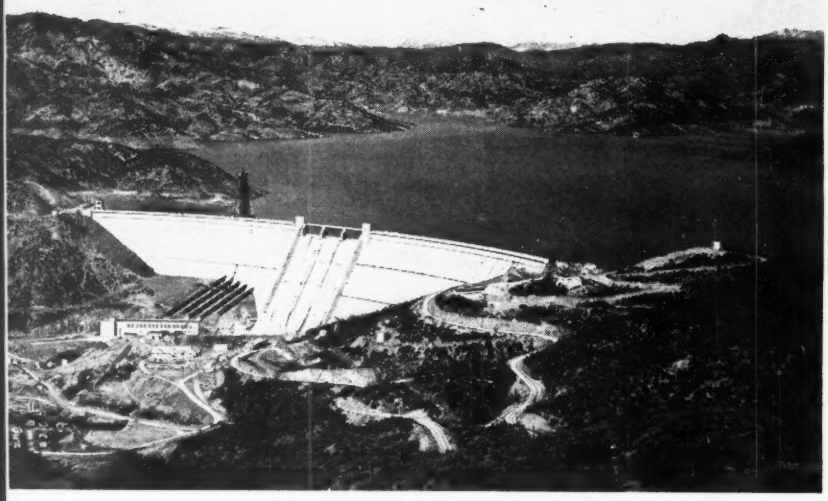


Fig. 4. A recent view of Shasta Dam with Mt. Shasta in the distance

fortunately, some of these plants should not operate their own power plants when considered from a purely economic standpoint but at the present time such power plants can be justified on a power "insurance" basis.

A not unimportant factor in the expansion of utility facilities is the problem of cost and financing. Fig. 2 shows the upward trend of construction costs for steam electric stations. High construction costs have been responsible to some extent for the increase in the number of semi-outdoor stations. While high construction costs have not deterred utilities from committing themselves to long range expansion programs, they are affecting overall operating costs to the point where it becomes necessary for utilities to ask for rate increases. The utilities have prided themselves upon the fact that whereas the cost of practically every other commodity has risen sharply over the last twenty-five years, the cost of electricity has steadily decreased. The time has come, however, when this can no longer go on, and in the face of rising costs, utilities will have to ask for rate increases. A few years ago, it would have been rank heresy, even in public utility circles, even to suggest such a move but today there seems to be general recognition that such rate increases are in order. Indeed, a valuable asset to the utility industry is the apparent public acceptance of those cases where modest increases in rates are necessary. As a matter of fact, when electric utility companies have found it necessary to ask for rate increases, they have been moderate in character. Study indicates that, assuming no further significant cost or price level increases, an increase in rates of something like 10 per cent would be sufficient, even in 1951 after large additions of capital have been made. Such a 10 per cent rate increase would overcome all the increases in fixed and operating costs and would provide a liberal return on the investment, sufficient to attract the needed additional capital.

The announcement last year that the utility industry would need six billion dollars of additional capital in the period between 1948 and 1951 makes it necessary to provide ways to attract this capital. While there has been some apprehension in the industry in this respect, the attraction of new capital should not be too difficult. The industry is in a good position, morally and economically. The rigid, and more or less standardized procedures which grew out of the Securities and Exchange Commission requirements and the investment world patterns during the refunding era, now seem to be giving way to financing programs with details tailored to needs and current conditions. As pointed out by Charles Kohlhepp, President of the Wisconsin Public Service Corporation in an address before the Great Lakes Power Club on October 8, of last year, the SEC is entitled to special commendation for its apparent willingness to waive compulsory competitive building requirements upon a clear showing that some other program gives better promising results.

Electric utility earnings, generally, are good. If modest rate increases are necessary to sustain them, or improve them sufficiently to maintain a high credit position and permit the securing of large amounts of new capital, there is every indication that our far-seeing regulatory commissions will do what is necessary.

It is quite apparent that the industry will not have to worry about load building programs for a long time to come. It will do well if it can keep abreast of the demand because the factors which governed the load increase during the last few years are still at work and will continue to be for at least another decade. The United States is, by far, the world's largest user of energy. Last year, this country accounted for 45 per cent of the total world consumption. Russia, the second largest consumer was credited with 11 per cent. In a per capita comparison, the United States looms even larger among the world energy consumers. Every man, woman, and child in this country uses, on the average, about 250 million Btu each year. This figure includes not only electrical energy but space heating, highway vehicles, ships, aviation, etc. Figure 5 shows the way in which the 40,000 trillion Btu we used in the United States is broken down.

At the present time residential customers account for approximately 19 per cent of the total electrical output. It has been estimated that in 1957 the residential load will account for about 22 per cent of the total load. Both because of population growth and the increased acceptance of electric power in household, the residential load is expected to continue to be an increasingly important factor, one which should be of particular interest to utilities because of the relatively high source of revenue from this class of customer. Another factor of great importance is rural electrification. Approximately 90 per cent of the farms in this country now have electric service available but the use of energy is very small. It now stands at about 2200 kwh annually.

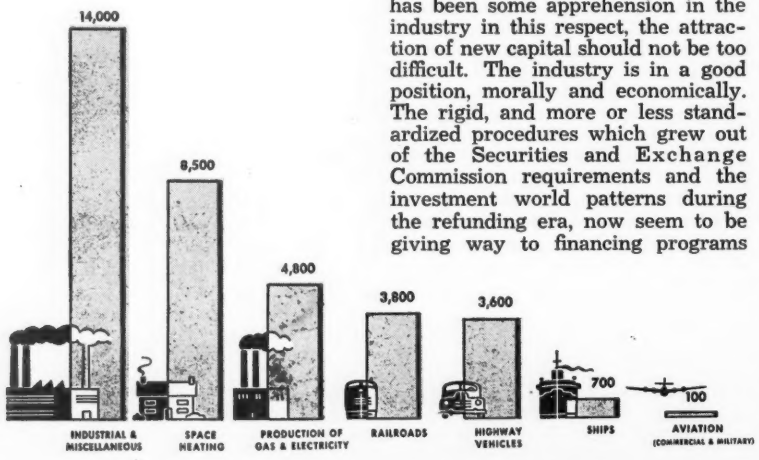


Fig. 5. End uses of energy used in the United States. Of the 40,000 trillion Btu used in the United States annually only 12 per cent is used in the production of gas and electricity

Coal Still Heads the Energy Parade

BRIGHT FUTURE for coal, the king of our energy resources, was discussed in our review of developments, POWER GENERATION, January, 1948. Many of the developments proposed and in early stages at that time have made good progress and their latest status is reviewed briefly below. Pending atomic energy power plants, coal will keep us going for a long time, even if oil and gas finally give out.

Just as this goes to press, announcement is made that the pilot plant of Pittsburgh Consolidation Coal Co. and Standard Oil Development Co., reported in POWER PLANT ENGINEERING, August, 1947 for experimental development of processes to produce synthesis gas, liquid fuels and gasoline, and power plant fuels, by treatment of coal as a raw material, has gone into operation.

The synthesis plant now under construction in Texas expects to make 7000 bbl per day of gasoline and Diesel fuel out of natural gas, along with other by-product hydrocarbons. The synthesis plant originally projected by Stanolind at Hugoton, Kansas (POWER PLANT ENGINEERING, August 1947) has been canceled because of high construction costs. But a plant for similar research will be built by the U. S. Bureau of Mines at Louisiana, Mo.

Preparations are now being made for a second underground coal gasification experiment by Alabama Power Co. and U. S. Bureau of Mines. The objectives were outlined in detail by James Boyd in POWER GENERATION, October, page 133.

Fluid devolatilization of coal for extraction of gases, elimination of sulphur and preparation of fuels for industry, was explained by A. D. Singh, POWER PLANT ENGINEERING, October 1947. This development has progressed so well that at least one commercial full-scale installation of a plant for fluid devolatilization has been contracted for, and is now being designed.

The entire fuel reserve situation was thoughtfully analyzed by John Van Brunt before the 1948 Midwest Power Conference. Figures for reserves, he pointed out, cover only coal in the ground. If only half of that can be shipped, if consumption increases at present rates, then making many allowances and arbitrarily halving the USGS data, we would have about 1000 years of coal reserves. If coal consumption increases in 1957 to 20 per cent above 1947, the reserve drops still more. Production of gasoline and fuel oil from coal might require 700,000,000 tons of coal a year. Add this to estimates of 800,000,000 tons of coal for utilities, industries, export and the like, that may be required by 1957, and we may need 1,500,000,000 tons of coal a year then. That would reduce our coal reserves to 400 yr.

The Bureau of Mines and the Geological Survey are planning a cooperative survey to determine the present coal reserve situation.

Above factors demand more attention to development of machinery for the low-cost continuous mining of coal.

Recovery of oil from shale is being investigated by the U. S. Bureau of Mines in an experimental processing plant at Rifle, Colo. where there is a large deposit of oil shale.

Catalytic cracking plants for manufacture of gas for gas utilities from natural gas, propane, butane and other pipeline gases have recently been announced by Surface Combustion Corp.

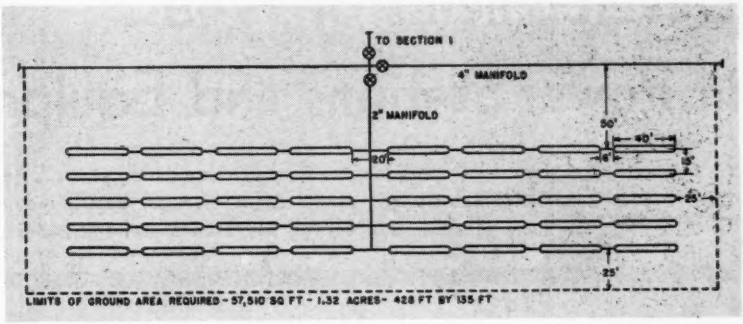


Fig. 1. Arrangement of one section of underground pipe storage for gas at Mt. Prospect, Ill. Section consists of 40 lengths (about 40 ft each) of 24-in. O.D. alloy pipe, formed as shown, buried in trenches. Each of the sections shown above stores 1,000,000 cu ft gas at 2240 psi, there are 40 such sections, total capacity 40,000,000 cu ft, and field is planned for ultimate capacity of 70,000,000 cu ft. Equivalent conventional gas holders would cost 3 to 5 times as much (D. V. Meiller, before WSE. Storage field engineered by Stone & Webster Eng. Corp. for Public Service Co. of No. Ill.)

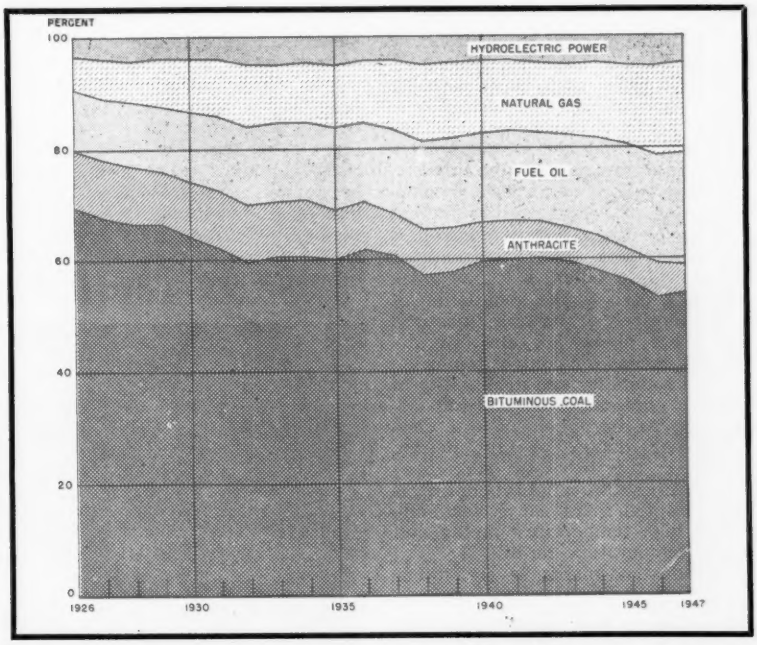


Fig. 2. Proportionate sources of energy in the United States. This curve includes such coal, oil, natural gas and hydroelectric power as are consumed in direct competition. It does not include energy in the form of gasoline and lubricants, nor natural gas used in production of carbon black (Bituminous Coal Institute)

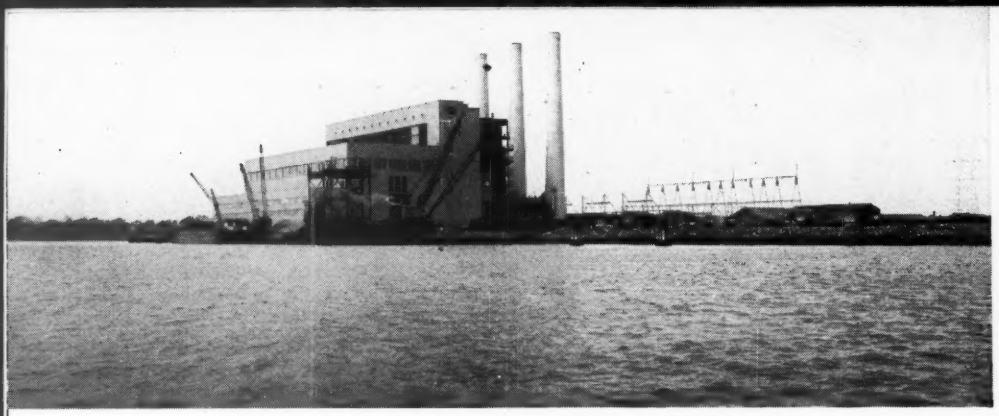


Fig. 1. Sewaren Generating Station of Public Service Electric and Gas Co. (N. J.) as it appeared October 26, 1948, from permanent end. Initial installation, three turbine-generators, each served by one boiler. This is the first 1050-F station to go into operation; first two 100,000-kw units are now in service

Developments of 1948 in Power Stations and Equipment

First 1050-f station goes into operation during year . . . Reheat comes back . . . Simplified design, semi-outdoor stations, centralized control standardized units all aid in cost cutting . . . New Diesel and hydroelectric developments

ATTENTION was called a year ago to the new 1050-F level of steam temperature to be reached by some of the stations now being built. One of these stations is now in service. Rising fuel prices and the attainment of the 1050-F temperature level again make reheat attractive, and several of the new plants will use this cycle. A new mercury-vapor cycle power plant is being designed. The first gas turbine power plant for electric power generation is being installed in an existing steam station, while another stationary gas turbine will be installed for compressor drive on a natural gas pipe line.

Necessity for cutting costs, by simplification of design and equipment and by centralization of control, is still paramount. One of the methods being widely adopted to cut construction costs is the installation of boilers entirely or partially unhoused and some plants are entirely unhoused except for control rooms.

High reliability and availability of modern equipment permits full advantage to be taken of the one-boiler-per turbine, or unit, design, principle; this promotes simplification, aids centralization of control, is well adapted to reheat cycles, simplifies high-temperature piping and steam temperature control.

In industrial plants, several interesting large high-pressure installations are going into service. In all the medium and small-sized plants, necessity for keeping steam and power costs down, to offset increasing fuel prices, is paramount. The spreader stoker is finding wider application as practically all stoker manufacturers go into this field, while the pneumatic spreader also shows much development and application.

Sequential control of soot blowers, especially of compressed air blowers to save high-cost steam, is increasing. A new sequential system of ash removal and disposal from various hoppers in a steam generating unit has been developed. A sequential temperature recorder registers a large number of boiler and furnace tube or turbine bearing and generator temperatures, in sequence and in a short time.

Water treatment is making good progress, especially in reducing harmful silica deposits. Chemical cleaning of all sorts of power units is well established.

Diesel engine development includes the new dual fuel engine, the new radial Diesel for stationary service; new developments in adapting four-cycle Diesels to use of gas.

The cyclone burner, for burning crushed coal in suspension, promises to have additional applications in stations now under construction. New steam generating units fired by cyclone burners are being designed for five large central stations in the Chicago area. Also, an important industrial installation of a 1450-psi, 900-F steam generating unit at Dow

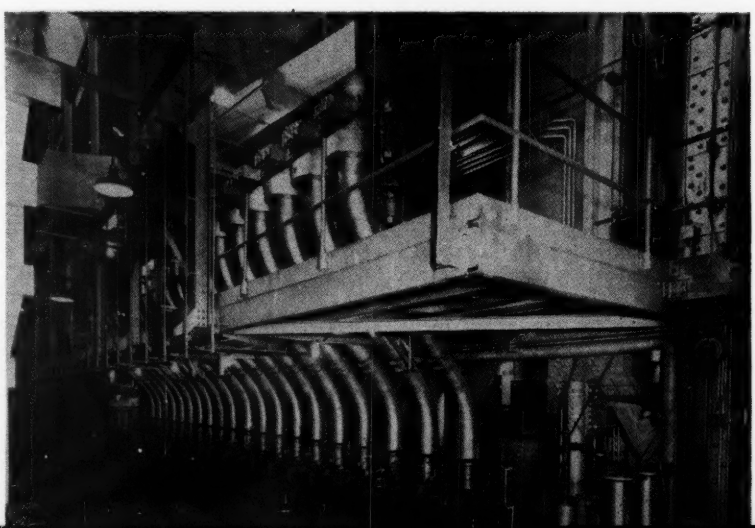


Fig. 2. View on boiler operating floor, Port Washington Station, Wisconsin Electric Power Co., showing burners for Unit No. 3 steam generator, 700,000-lb-per-hr, just placed in service

Chemical Co. is under construction, to be fired by cyclone burners, the furnace being designed for pressure operation.

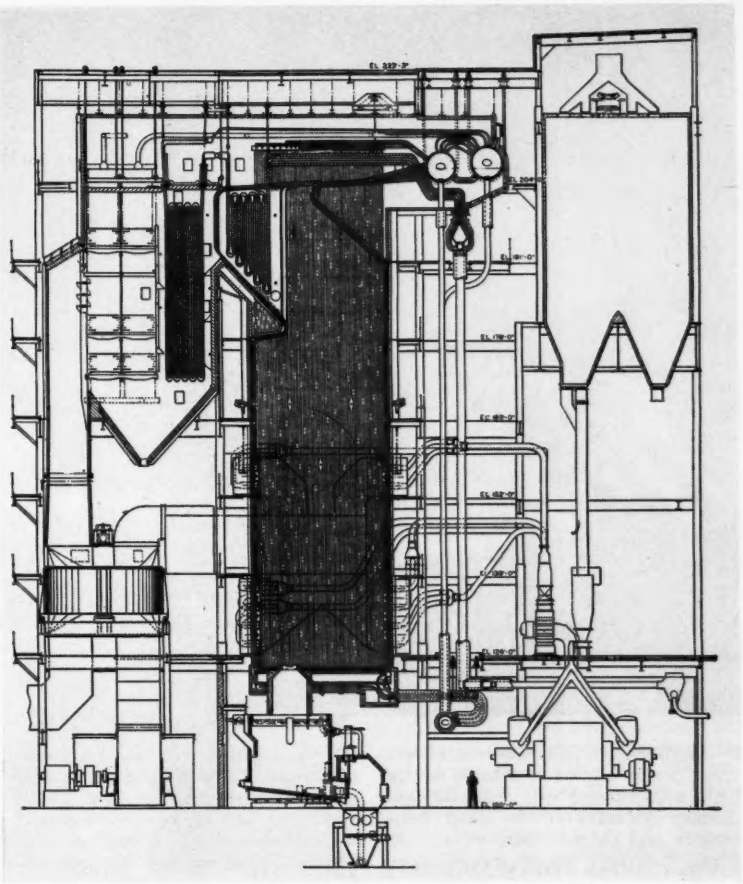
An interesting industrial power plant for Standard Oil Co. (Indiana) was placed in operation at the Whiting refinery during the year, as described (1) in these pages.

This is a 20,000-kw, 1250-psi, 900-F topping plant, using 100 per cent feedwater makeup and having dual circulation boilers to reduce blowdown losses and water treatment to prevent silica carry-over.

1050-F Stations

Progress continues rapid in the design and construction of several of the plants for the new top level steam temperature of 1050 F. In line with the statement in POWER GENERATION, January 1948, Sewaren Generating Station of Public Service Electric and Gas Co., (N. J.) is the first of these 1050-F plants to go into operation. Initial installation here consists of three 100,000-kw, 1500-psi, 1050-F tandem-compound turbine generator units, each supplied with steam by an 850,000-lb-per-hr boiler. The ultimate installation is designed for four turbines and four boilers. Two boilers and the first two turbine generators are now in operation and the third turbine generator will be placed in service in the fall of 1949.

One of the features of Sewaren is its design with about half of each



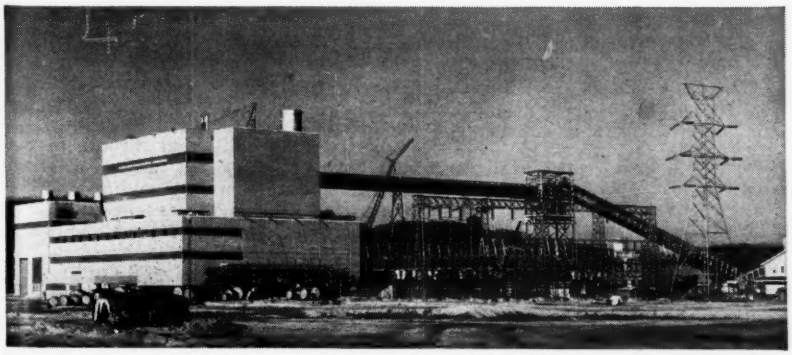


Fig. 3. General view of new Willow Island Generating Station of Monongahela Power Co. Initial installation, one 50,000-kw turbine-generator unit

Fig. 4. (Above). Cross-section and side arrangement of one of three Combustion Engineering Co. 850,000-lb per hr, 1500-psi, 1050-F steam generating units at Sewaren Generating Station. About 50 per cent of heat radiating surface of boiler and auxiliaries outdoors. Enclosed space ventilated with 100 per cent filtered air

boiler and many of its auxiliaries outdoors; the turbine generators are indoors in the conventional manner. Principal characteristics of one steam generating unit are shown in Fig. 4.

The top steam temperature of 1050 F will also be used in the completely new Philip Sporn Station, in Ohio, where No. 1 and No. 2 units will each be of 125,000 kw nominal capacity, each supplied with steam by a single 935,000-lb-per-hr boiler at 2000 psi 1050 F, with reheat to 1000 F. A feature here, (2) will be that the boiler furnaces will be designed for operation at pressure of 15 in. H_2O. Another similar unit, No. 5 at Twin Branch Station, is also under construction.

1000-F Stations

Of the stations for 1000 F, the second unit to go into service was the new No. 1 unit at Essex Station, put in operation late in 1947. This is a 100,000-kw, 1250-psi, 1000-F tandem-compound machine. One feature of this installation is complete elimination of steam auxiliaries—air soot blowing, use of rotary vacuum pumps instead of steam jet air ejectors, etc. Draft fans, air preheaters and precipitators are installed outdoors on the roof.

Another 1000-F unit now in service is that at Suburban Station of Scranton Electric Co., (3).

Other units for 1000 F are being contemplated for East River Station, Edgar, Dunkirk, Titus and Salem Harbor—all for installation between 1949 and 1951.

Reheat and Unit Designs

Many of the stations just named will be designed for the reheat cycle, as well as the Philip Sporn and Twin Branch units previously mentioned. The latest unit, No. 3, at Port Washington, an 80,000-kw machine recently placed in operation, also has reheat. Reheat at the new high steam temperatures can yield heat rates as much as 3 to 5 per cent better than non-reheat cycles.

In most new plants, the unit design, or one-boiler-per-turbine, is favored in the utility field. It leads

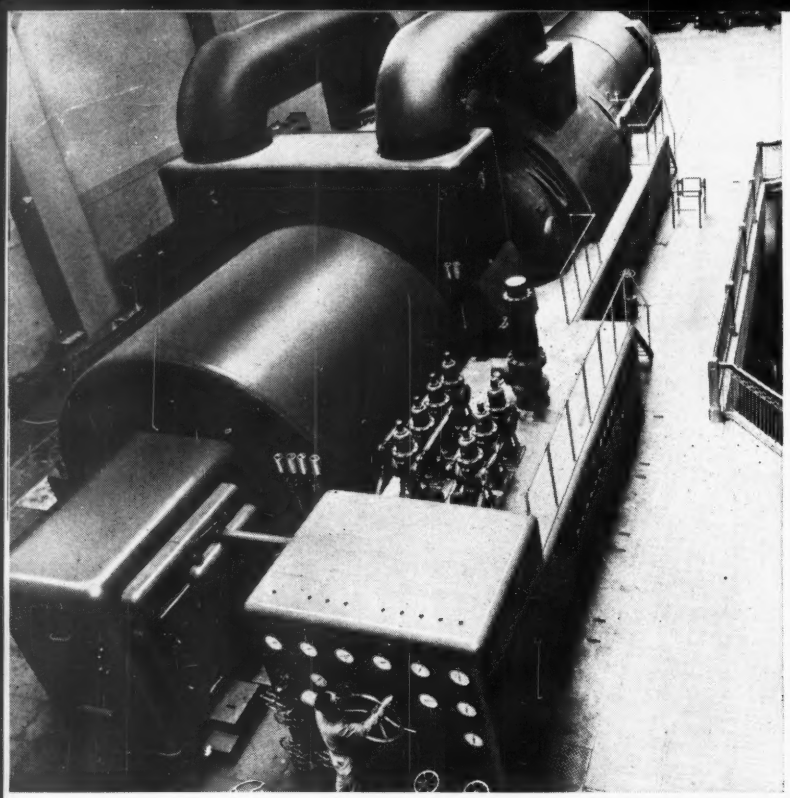


Fig. 5. View of Unit No. 3, Port Washington Plant of Wisconsin Electric Power Co., put on the line late in 1948. Turbine is tandem-compound, 1290-psig, 850-F unit with reheat at 850 F, exhaust at 29.5 in. Hg. Concentric hydrogen coolers reduce generator housing and cut total hydrogen volume in half

to simplification of design, thus lowering costs; and is a tribute to the high availability and reliability of modern steam and electrical generators and their auxiliaries.

The Suburban Plant of the Scranton Electric Co., burning pulverized anthracite, went into operation (3) in April 1948. This station is the first one burning pulverized anthracite to operate at 1000 F steam temperature. Another important anthracite-burning installation on which construction has been going forward during the year is the new Sunbury plant of Pennsylvania Power & Light Co. Of special interest was the detailed report on the first two years of operation at Jennison Station, (4) which burns anthracite not in pulverized form but on the largest traveling grate stokers in utility service.

Redondo Steam Station (5) besides being of semi-outdoor design, had earthquate design, provision for reversal of condenser water flow and design for quick load pick-up.

In many cases, there is much interest in the use of models in designing steam stations, either to display the appearance and characteristics of the entire station or in the form of working models of components, Fig. 7, for engineering analysis of proposed design and construction.

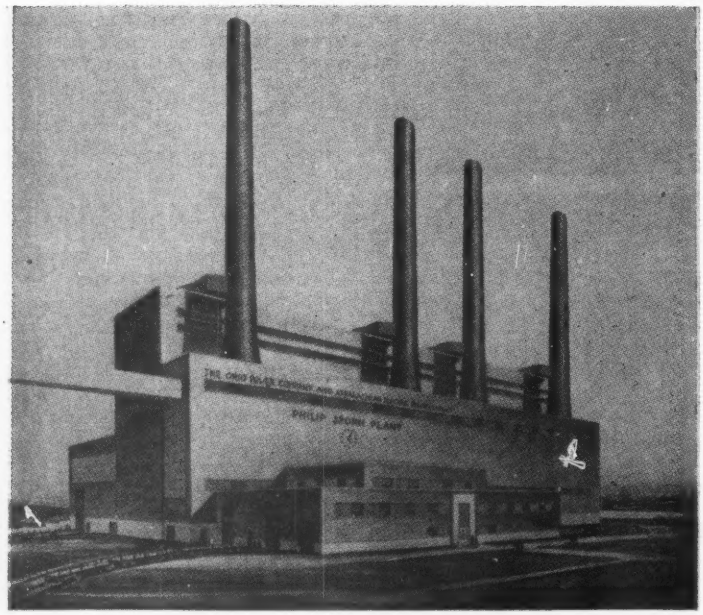


Fig. 6. Architect's view of new Philip Sporn Station, to be built for 2000-psi, 1050 F, reheat to 1000 F

Feedwater Problems

Much activity in the field of boiler water treatment is evident and a wide variety of processes is now available to suit various conditions.

Prevention of silica deposits in superheaters and turbines is imperative to prevent costly shutdowns; full details of various water treatment methods designed to do this have been presented during the year. There is much interest now in the demineralizing process in connection with silica reduction, but other methods are being advocated and each case is studied individually, by competent specialists, and methods selected to fit it. A typical instance of the savings in operation and maintenance costs at a plant of Southern Advance Bag & Paper Co., resulting from silica removal from boiler water, was given in these columns (6). A review of the various methods of treatment and the modern trends was given here by S. B. Applebaum (7).

Smoke Abatement and Gas Cleaning

Smoke abatement activities increase in intensity because the problem must be attacked first to minimize emissions from some present equipment, which cannot be readily replaced or rebuilt; and second, to see that the causes of atmospheric pollution are understood and proper designs developed to prevent emissions, rather than more laws about smoke. It is becoming well understood that industrial and utility smoke is not the sole cause of air pollution. The work of Hebley, McCabe, Bubar, Lammers and a host of other workers is demonstrating that many industrial and meteorological factors are responsible for air pollution; that it must not be blamed entirely on fuel burning and, in particular, on coal burning; and that mere passage of city ordinances and "smoke laws" does not solve the problem.

All power plants that require it are equipped with mechanical, electrostatic or, in a few cases, washer-type precipitators for removing fly-ash from flue gas. Some of the newer stations are installing combination mechanical and electrostatic pre-

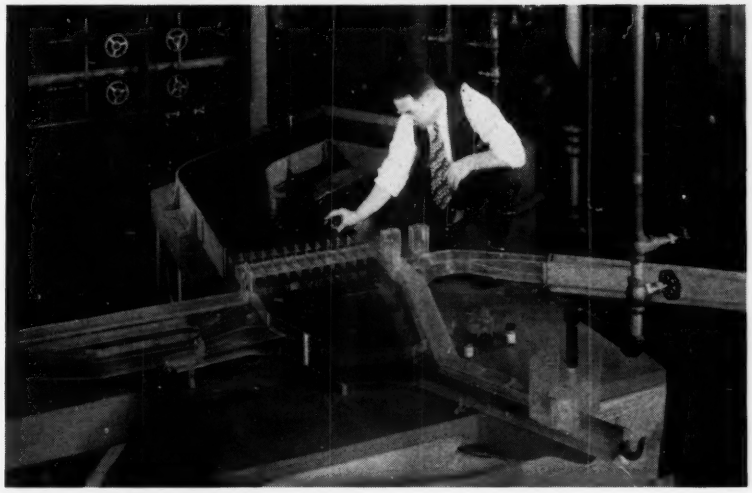


Fig. 7. (Right). View of scale model of circulating canals for extension of Conners Creek Station of the Detroit Edison Co., where two 100,000-kw units are to be added. This is a working engineering model, built of lucite, so every detail of water flow can be studied. P. E. Landback of D. E. Construction Engineering Dept. shown pouring water soluble dye into stream

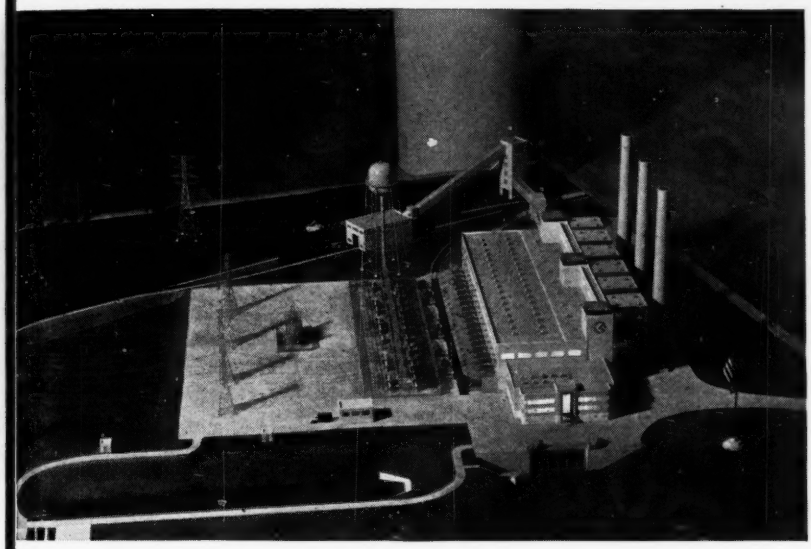


Fig. 8. (Below). Scale model of O. H. Hutchings Station of the Dayton Power & Light Co. Initial installation to be two 60,000-kw, 1300-psig, 950-F generating units, each served by one 600,000-lb-per-hr boiler, which is installed outdoors. First 60,000-kw unit now in operation. Ultimate development planned for 360,000 kw

cipitators. Much work is being done on effects of sulfur compounds emitted from stacks.

Standardization

Standardization continues to be of much influence and increasing interest to many power engineers. The NEMA has recommended standards for turbine generators from 500 to 7500 kw and the joint AIEE-ASME preferred standard turbine generators for 11,500 to 60,000 kw have been produced in increasing numbers for a number of the utility and municipal plants.

Hydrogen cooling is becoming standard on units of 20,000 kw and above. There seems to be a tendency to increase hydrogen pressures to 15 psi and in some cases to 30 psi.

While there is not the standardization in boiler design found in turbines, still the various manufacturers are developing standardized types that will fit many different situations, in capacities from 15,000 to about 300,000 lb per hr. Some manufacturers also have completely self-contained or "package" units for industrial use up to about 50,000 lb per hr that can be shipped in completely assembled units.

Steam the Big Industrial Problem

In industrial power plants, where process steam demands govern the design, most new plants producing electric power with extraction or back-pressure turbines generate steam at about 400 psi and approximately 700 F steam temperature. For industrial power generation, savings in fuel due to use of 400 or 600 psi steam generation, as compared with low-pressure steam, have been analyzed by Fulton (9).

All reliable estimates indicate that the total generation of steam in industrial plants for process and heating is much greater than the generation of steam by power utilities. Industry, however, has only about one-fourth as much capacity to generate electricity. Thus the problems of generating steam, burning fuel and utilizing large numbers of relatively small steam generating units and their auxiliaries, are extremely important in industry.

Large public and private buildings, universities, state hospitals and penal institutions present combinations of

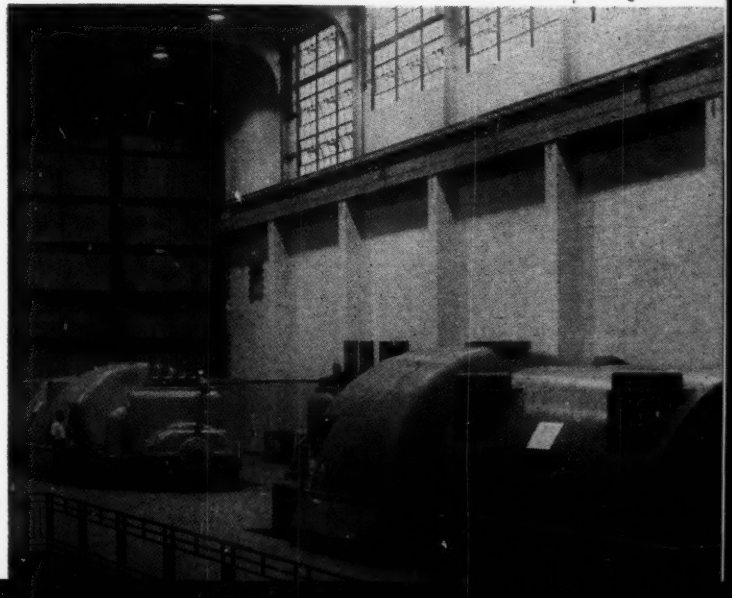


Fig. 9. Two 40,000-kw turbine generator units at Havana Station, Illinois Power Co. Ultimate design for 200,000 kw in five units

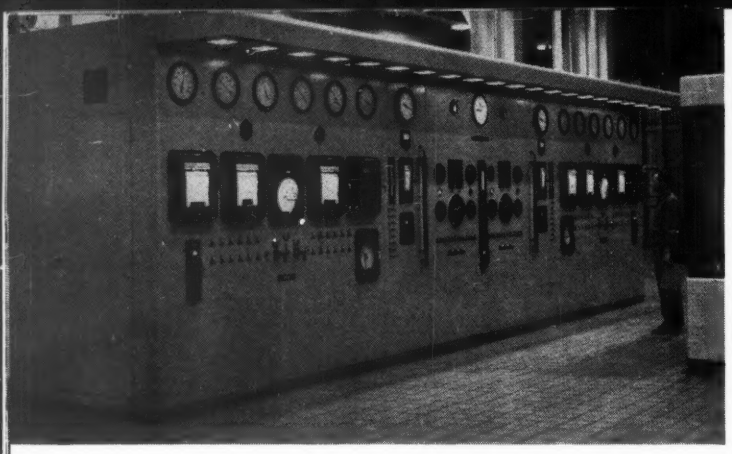


Fig. 10. Control panel for two 40,000-kw turbine generators at Havana Station. Controls for boilers on opposite side of panel (Leeds & Northrup photo)

problems in generation and distribution of steam, electricity, water, compressed air, sometimes more extensive and complex than in many industries. A typical illustration of their scope and the way they must expand with the demands was shown at the University of Illinois (10).

Progress in details of equipment and methods can be barely indicated here. Control of steam temperature at highest levels by gas dampers, superheat burners, divided furnaces, condenser type controls, attemperators, vertically-adjustable burners and other methods, is necessary.

Makers of boiler feed pumps are solving corrosion-erosion problems with alloy construction. Piping and valves develop to meet high-temperature stress and expansion problems. Draft equipment shows steady progress. Hydraulic couplings on fans and pumps drives, and magnetic couplings on fans, are increasingly used.

Centralization of Controls

Automatic controls and instruments for all types of stations—both utility and industrial—are increasing in importance, not only to centralize control and minimize attendance, but also for safety and economy on load swings. There is much development in pneumatic and electrical transmitters both for control and telemetering.

Many boiler plant operators are interested in the various oxygen meters being brought out, for use in measuring flue gas oxygen in addition to, or instead of, carbon dioxide meters. Several electronic types of CO_2 meters are now available, some using the hot wire and Wheatstone bridge principle. A recent meter uses the magnetic properties of oxygen as its basis of measurement. With boiler pressures and temperatures rising, the problems of water level control with small water volumes in modern boilers are being met successfully by modern feedwater level and feed pump controls. using one, two or three-element controls to suit the conditions.

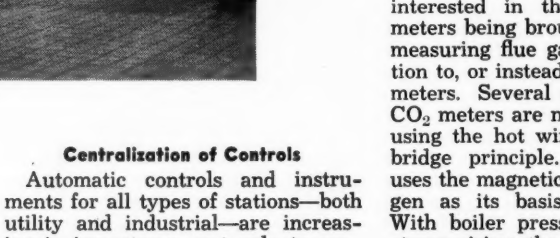
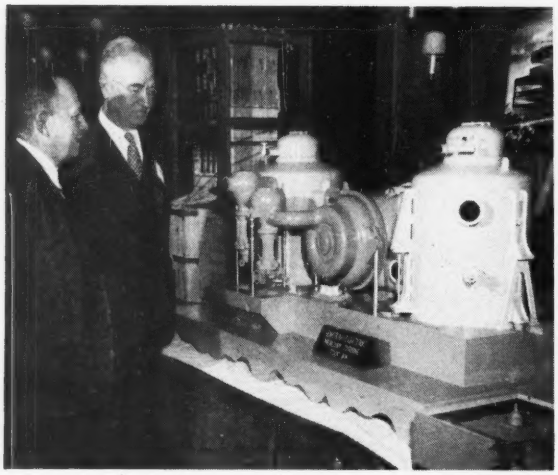


Fig. 11. (Left). View of a 3000-kw, 3600-rpm non-condensing, 400-psi, 750-F, 25-psi-back-pressure turbine-generator set at U. S. Gypsum Co's South Gate, Calif. plant. Cooler inside housing; nozzle provided for uncontrolled extraction at 175 psig. (Allis-Chalmers photo)

Fig. 12. (Below). Scale model of 7500-kw mercury turbine, for Portsmouth Station of Public Service Co. of New Hampshire. Two such 7500-kw mercury units will furnish steam for a 25,000-kw steam turbine generator—total capacity 40,000 kw. A. R. Schiller, PSCNH president, (left) and T. S. Knight, GE vice president, view model (General Electric Co. photo)



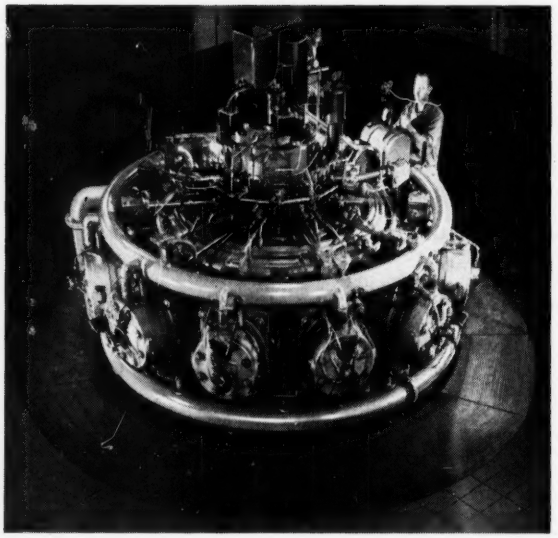


Fig. 13. (Above). View of new 1800-hp radial Diesel engine for heavy duty stationary service. (Nordberg Mfg. Co. photo)

Table giving summary of Power Development Program, Bureau of Reclamation, U. S. Dept. of the Interior—1947 through 1957

Fiscal Year	Power Plant Cost By Years (Dollars)	Transmission Line Cost By Years (Dollars)	Power Capacity Added Yearly (Kilowatts)	Transmission Line Completed in Year (Miles)
Existing June 30				
1947	.....	.....	2,202,400	2,579
1948	30,000,988	18,986,616	675,000	633
1949	36,089,230	38,618,140	162,500	1,396
1950	75,805,688	54,338,696	715,600	1,721
1951	103,334,051	41,811,328	703,900	1,585
1952	120,110,562	49,918,173	565,900	1,130
1953	116,116,462	54,859,801	998,100	1,727
1954	100,340,997	75,706,135	663,998	1,700
1955	100,578,270	92,139,968	914,002	2,940
1956	103,330,072	83,779,420	1,399,800	3,850
1957	70,525,480	50,603,050	593,800	3,033

Internal Combustion Engines

In the Diesel field, principal developments of the year were increased applications by several manufacturers of the dual-fuel Diesel, in which either gas or oil may be burned and change-over made from one fuel to the other very rapidly.

Another development is the application of a principle to the 4-cycle gas engine designed to produce 14 per cent more power and cut fuel costs 20 per cent. This utilizes a simple gas injection system similar to that on atmospheric gas-fuel engines.

Hydroelectric Developments

Among the important developments of the year in this field are the increasing use of welding in both the construction and maintenance of hydraulic turbines, use of stainless steel to resist cavitation, both in new units and in repair of existing units. Large and small hydraulic turbines have been shop fabricated of welded plate steel in place of steel castings, due partly to lower cost of welded structures and partly to difficulties in obtaining sound castings. A number of cast stainless steel runners, of which Fig. 16 is typical, have been manufactured.

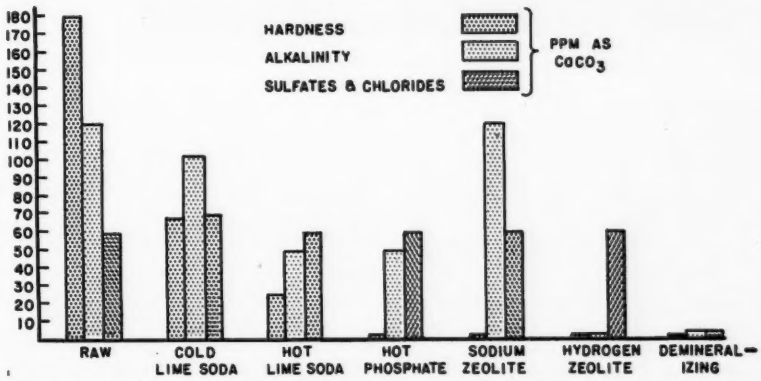


Fig. 14. Graphic results of treating a given water by six different water-conditioning methods, as given by S. B. Applebaum

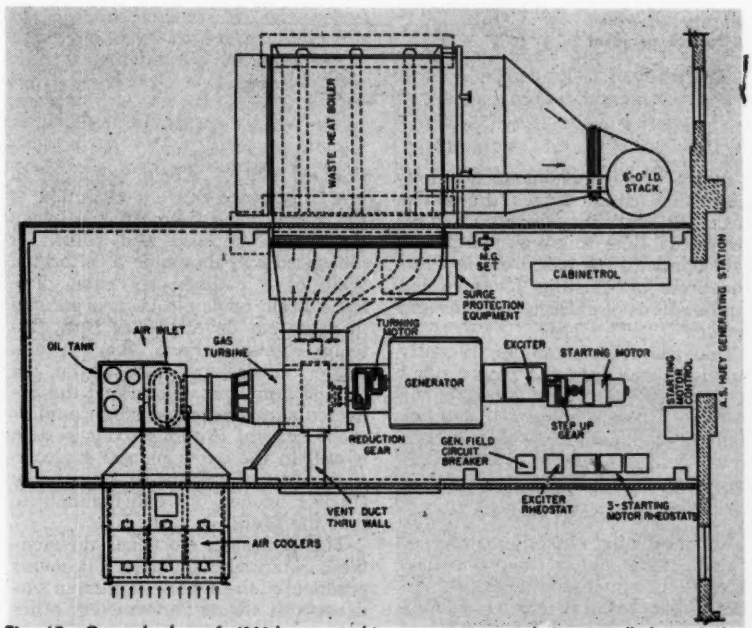


Fig. 15. General plan of 4000-kw gas-turbine generator set being installed at Arthur S. Huey Generating Station of Oklahoma Gas & Electric Co. (Pioneer Service & Engineering Co. drawing)

Another new use for welded steel construction is in the power plant buildings for hydroelectric plants, breaking away from the traditional use of concrete, as described in detail by Aftreth and Perry (12).

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Fig. 16. Cast stainless steel runner for 17,000-hp hydraulic turbine for Brazos River Plant (Allis-Chalmers photo)

ELECTRICAL

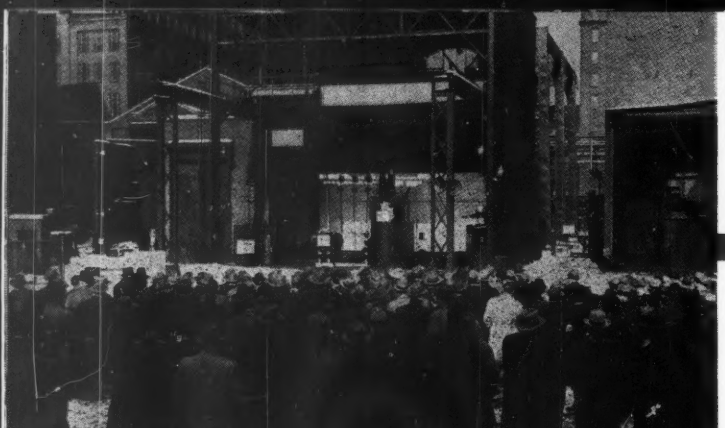

Fig. 1. Demonstrated before a group of AIEE engineers during an inspection trip at the Westinghouse plant at East Pittsburgh early last year, this experimental circuit breaker successfully interrupted approximately the equivalent of five million kva at 345 kv. This was the greatest amount of power ever handled at this voltage

A FEW WEEKS AGO, in Washington, D. C., David Sarnoff, head of the Radio Corporation of America, sent a radio message, which, contrary to a life-long habit he didn't bother to count. It was fortunate for those who watched him that he didn't count the words for there were about a million and a half words in the message. Indeed, the number of words didn't matter—RCA engineers had come up with a message sending system which they declare will presently make word counting, even the telegram itself, as obsolete as the pony express.

Using this revolutionary system—Ultrafax, it is called, the RCA engineers flashed the whole of the 1037-page novel, Gone With The Wind, from the Wardman Park Hotel, crosstown, to the Library of Congress in just 90 seconds flat. Just about a million words per minute.

It sounds incredible and, offhand, very complicated, yet it is very simple. It is simple because now we have television and photography. Put photography and television together and you have Ultrafax.

Here is how it is done. RCA engineers first reduced Gone With The Wind to microfilm—a page to each frame. Then, unreeling the 40 ft of film in front of a television camera, the latter scanned the film at the rate of 15 pages per second. At the other end, a motion-picture camera in front of a television screen and synchronized with it, took pictures at the same rate.

Startling as this development is, it is typical of the phenomenal development that characterizes the entire electrical art in all its various branches. Like this one, many new developments are based on new applications of existing ideas or on combinations of existing systems and devices.

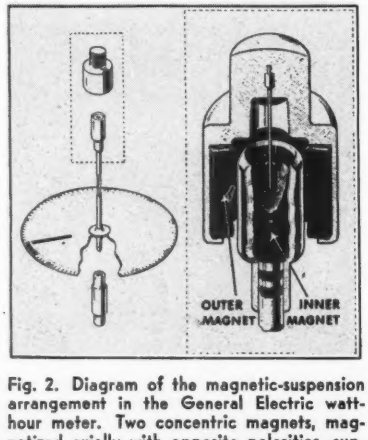

Fig. 2. Diagram of the magnetic-suspension arrangement in the General Electric watt-hour meter. Two concentric magnets, magnetized axially with opposite polarities, support the moving system in equilibrium

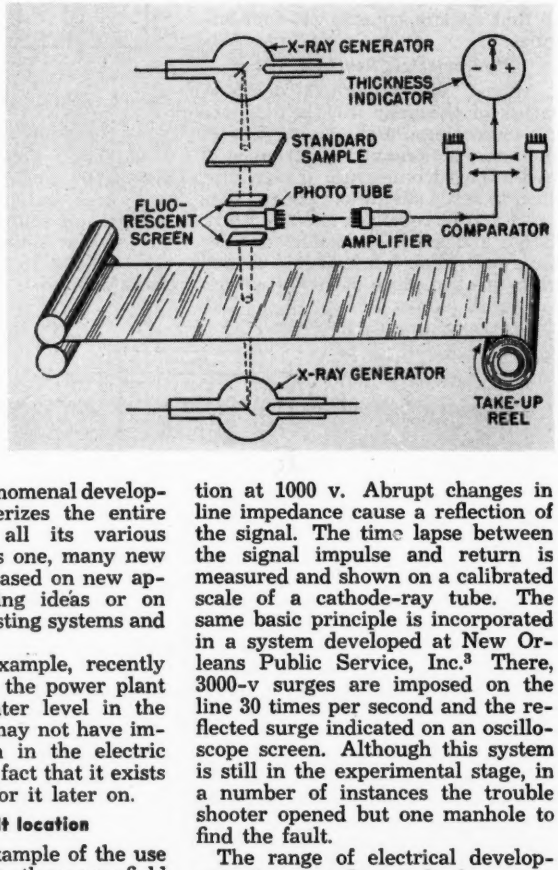

Fig. 3. This diagram shows the components of the X-ray thickness gage used in the continuous measurement of steel strip as it passes through the rolling mill. The range of this gage is 5 to 50 thousandths of an inch with accuracies up to one per cent

Television, for example, recently found its way into the power plant to monitor the water level in the boilers.[1] Ultrafax may not have immediate application in the electric power field but the fact that it exists may suggest uses for it later on.

Radar in fault location

An interesting example of the use of radar technique in the power field is seen in a method developed recently for locating faults on the transmission lines of the Puget Sound Power & Light Co.[2] The new device is a combination high-voltage pulse generator and synchronized oscilloscope receiver which gives direct visual indication of abrupt impedance changes on a line. Such changes may be caused by open circuits, short circuits, or variations in line configuration. In operation the unit continuously generates sharp d-c pulses of 5 micro-second duration at 1000 v. Abrupt changes in line impedance cause a reflection of the signal. The time lapse between the signal impulse and return is measured and shown on a calibrated scale of a cathode-ray tube. The same basic principle is incorporated in a system developed at New Orleans Public Service, Inc.[3] There, 3000-v surges are imposed on the line 30 times per second and the reflected surge indicated on an oscilloscope screen. Although this system is still in the experimental stage, in a number of instances the trouble shooter opened but one manhole to find the fault.

The range of electrical development is tremendous, indeed it covers practically the whole of human endeavor. It affects almost every other field; electricity is as much a part, for example, of biological research as it is of steel production. It enhances

the effectiveness of almost all our senses. It enables us to talk faster and farther, to see better, farther, smaller and faster; it increases our sense of touch a million fold, indeed, recent research indicates that before long we will have the electronic detection of odors.

Early in the year announcement was made of a motion picture camera that would take pictures at the rate of five million frames per second.[4] This is fast yet compared to a still newer all-electric camera developed by U. S. Navy scientists, it is nothing for this camera—the Zarem camera—is potentially capable of taking pictures at the rate of 100 million frames per second.[5].

Permenorm 5000-Z

Of great interest to electrochemical companies, users of large amounts of low voltage direct current, are the new mechanical rectifiers developed in Germany during the war and more recently reproduced in this country by ITE Circuit Breaker Co.[6] These units operate at efficiencies of as high as 99 per cent and are capable of rectifying alternating currents at voltages down practically to zero. The success of these rectifiers depends on the use of a commutating reactor which alters the voltage wave shape so that the voltage remains at zero for an appreciable length of time thus giving the mechanical contacts time to open and close. The effectiveness of these commutating reactors in turn depends upon the use of a special magnetic alloy which gives a square hysteresis loop. Produced first in Germany, the alloy was successfully duplicated this year by scientists at the U. S. Naval Ordnance Laboratory.[7] Aside from the value of this alloy, known as Permenorm 5000-Z, in rectifier design, it has, perhaps, even greater value in the design of magnetic amplifiers. In this application it becomes possible to replace many complicated, delicate, and troublesome electron tube amplifiers in guided missiles, fire-control equipment, and underwater ordnance.

A novel development in the field of mechanical transmission is a new type of electromagnetic clutch developed at the National Bureau of Standards.[8] This clutch operates on the following principle: When the space between two parallel magnetic surfaces is filled with finely divided magnetic particles, and a magnetic field is established between the two plates, the particles bind together against movement parallel to their surfaces. The particles may be finely divided iron which for most applications is mixed with a liquid such as oil to prevent packing. When a portion of this mixture is acted upon by a magnetic field, the iron particles are mutually attracted, they bind together in the field and the mixture seemingly "solidifies." Tests show that the clutch is easy to control and requires very small amounts of electric power.

In the field of electrical instruments, an interesting development of the year was a new watthour meter employing magnetic suspension of the rotating element. This principle, of course, is not new, the idea, in fact, was incorporated in a patent granted to Stanley and Darlington (Pat. No. 588,666) as far back as 1897 but at that time adequate magnetic material was not available and the invention failed to attain its peak success. This success is, however, attained in the new General Electric meter.[9] In this meter a small amount of magnetic material supports all the weight of the disk and shaft and eliminates the need for jewel bearings which have been the main cause for maintenance. In the conventional jeweled bearing, the bearing stress due to the weight of the disk is of the order of 200,000 lb per sq in. In the magnetically suspended moving element, the bearing stress due to the weight of the disk has been completely eliminated. Moreover, the torque-to-weight ratio, which has long been accepted as being in the order of 3 or 4 to 1, has been increased to infinity.

Of particular interest to utility engineers is a new transformer turn ratio test set developed by James G. Biddle Co. This is a direct reading portable instrument to determine the turn ratio of all types and sizes of transformers. It reduces to a simple operation what heretofore has been a somewhat difficult task. The set consists of a multi-ratio reference transformer which is excited by means of a small hand generator—in parallel with the transformer under test. By means of four dial switches and a null balance indicator, the reference transformer is adjusted in ratio equal that of the transformer under test.

Spectacular both in its application and in its operation is the x-ray thickness gage for continuous strip mills.[10] The application of this gage is not limited to steel mill operation, however; there are hundreds of applications for it since it is well suited to the measurement of thickness of linoleum, plastic, glass, paper and cardboard. Basically, x-ray gaging is accomplished by irradiating the material under test and, in effect, measuring the drop in radiation intensity through that material. The general arrangement of the equipment is shown in Fig. 3.

Turbine Generator Units

Last year marked the third year since AIEE Standards 601 and 602 covering large 3600 rpm condensing steam turbine generators were officially adopted in 1945. As a test of the progress made as a result of the adoption of these standards, a survey was made and the results tabulated.[11] This survey showed that all of the standard line units are now available with the exception of the 15,000 kw rating. Purchaser acceptance has been wide and the number of units and total kva on order

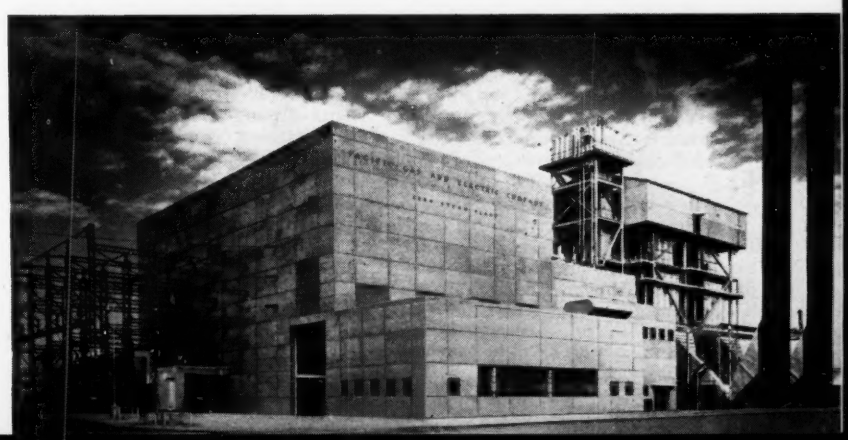

Fig. 4. A view of the new Kern steam-electric plant of the Pacific Gas and Electric Co. at Bakersfield, Cal. The outdoor boiler equipment can be seen at the right

represents 35 to 40 per cent of the total turbine-generator business for units of 10,000-kw rating and above.

Another development in turbine-generator manufacture is the construction of large units so that they can be shipped with the rotor in place. During the year the first 60,000 kw generator was shipped by Westinghouse completely assembled with the rotor in place.

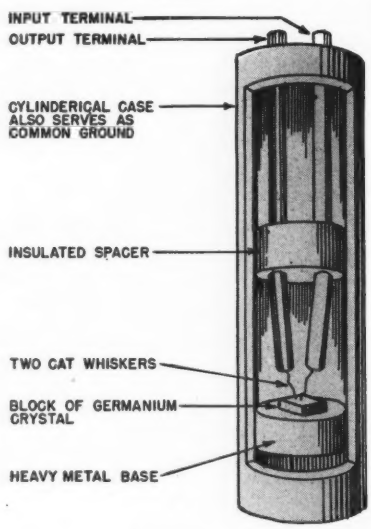

Fig. 5. Cut-away view of the transistor showing the two cat-whiskers in contact with a small block of germanium

Considerable attention has been given to the improvement of exciters for large turbine-generators operating at 3600 rpm. While the 3600 rpm direct connected exciter has performed on a satisfactory level, studies have shown that the exciter had a poorer availability record than the rest of the turbine unit. Much of the trouble was with the brushes. It is impossible to design brushes that will last from shutdown to shutdown so a new line of direct-connected exciters has been designed for continuity of operation. These use pedestal type bearings and to shorten the distance between bearings, the armature diameters were made larger and the core lengths shorter. To simplify ventilation, the exciter was turned around with the commutator toward the a-c generator. The ventilating fan has two sets of blades with a common discharge. Large blades cool the exciter and the smaller ones draw ventilating air over collector rings and brushes of the a-c generator. Exciter and pilot exciter are a complete unit.

As indicated in our review of electrical developments last year[12] a 500,000-v test transmission line was placed in operation in October 1947. Results of further research in the use of this test line has not been disclosed but it is presumed that data is being accumulated which will aid in the development of methods for electrical transmission at higher voltages than those in use at present.

In the field of switchgear a notable achievement was the interruption by an experimental circuit breaker of the greatest amount of power at 345-kv ever handled. This test, conducted at Westinghouse, involved the interruption of approximately five-million kva at 345 kv. (Fig. 1).

Curiously enough, thinking in Europe in regard to high voltage transmission is more ambitious than ours. In France, it is hinted engineers are playing around with the idea of installing an extensive 380 to 400-kv system.[13]

Interest in high-voltage transmission is also active in Sweden and Swedish engineers indicate that there is a possibility of setting up an inter-European 400-kv line if the French go through with their plans. France has a 500-kv experimental station at Chevilly, France.

Electron Tubes

In the field of electronics the number of different types of tubes is continually increasing. Tubes are being developed for every conceivable application and purpose.[14] Tubes commonly employed cover a frequency range of from 25 cycles to 30 billion cycles per second and they vary enormously in size and capacity. Tubes are available that will detect a current of 10^{-16} amp; others deliver as high as 10,000 amp. Similarly, tubes will respond to potentials of a few microvolts and yet the modern betatron deals with a hundred million volts.

There is a continuing trend toward the development of miniature and sub-miniature tubes. How far this trend will continue toward ever smaller sizes is anybody's guess. A "microtube" developed by the Bureau of Standards has been described as a "grain of rice" size and, indeed, it is scarcely larger than a grain of rice.

In the field of large tubes one of the most interesting trends in tubes of this class is the marked tendency toward the use of larges sizes. The line of demarcation between the sealed type of ignitron or power purposes and the pumped type is rising to larger and larger ratings. The 400 amp per anode type sealed tubes brought out in 1947 found ready acceptance in 1948. This represents a doubling of the amperes per anode over the previous largest sizes.

No review of electrical developments during 1948 would be complete without emphasizing the importance of a new device called the Transistor.[15]. This device is Bell Telephone Laboratories' latest contribution to electronics. Working on an entirely new principle, this device, which is not a vacuum tube, will serve as an amplifier or an oscillator. Indeed, the transistor will perform nearly all of the functions of an ordinary vacuum tube, but it involves no vacuum, no glass envelope, no grid, no plate, no cathode and therefore, no warm-up delay. Contained in a simple metal cylinder, scarcely larger than a pencil eraser, the transistor produces amplifications as high as 100 to 1—20 decibels. Essentially, the transistor is a triode form of the well-known germanium crystal diode. Two 2-mil tungsten wires make "cat whisker" contact with the upper face of the germanium at points 0.002 in. apart. One of the cat whiskers is in the input circuit, the other in the output. When a small current is passed through the input circuit, it affects the electronic structure of the germanium in the area surrounding the point of contact. Since the output cat whisker makes contact in this area, the current in the output circuit is modified by the current in the input circuit. This produces the basic mechanism of amplification. Naturally, these devices because of their inherent simplicity can be expected to have many uses. In one demonstration of the Bell Laboratories a transistor circuit was used as a telephone repeater. In another, a tubeless radio receiver was operated satisfactorily. The fact that these amplifiers require no heater current and therefore produce no heat makes it possible to concentrate many of them in a small space. They will undoubtedly replace conventional vacuum tubes in a great many applications. One field of application for which they show great promise is in the construction of electric computing machines.

Development in the field of electric computing machines continues at a rapid pace and this development is noticeably affecting technological progress.[16] Many problems that have been heretofore economically insoluble are being brought under control. In the military field new weapons of amazing accuracy and power are being investigated. Of particular interest to engineers is the increasing attention being given the so-called analogue computer. The analog computer or continuous computer compares the performance of one physical system with that of another having the same differential equations. Measurements are made on one physical system (known as the analog) to determine the behavior of the system in which the problem exists. Thus, it becomes possible to solve problems in heat balance of power stations in terms of electrical quantities.

Communication

In the field of electrical communication an extremely important element is the continual expansion in our facilities for transmitting wide ranges of frequencies. These involve both ultra high space radio systems

and coaxial lines. Development of the coaxial system by the Bell System began some years ago with the installation of coaxial cables between New York and Philadelphia and between Minneapolis and Stevens Point, Wis.[17] Today, there are about 5000 route miles of coaxial cable in service providing almost three million miles of two-way telephone service plus television network facilities. Miami, Fla., can now talk over coaxial systems across the continent to Los Angeles, Cal.—if they are on speaking terms—and it is possible

Fig. 6. The first portable civilian walkie-talkie radios to be produced commercially were announced by Sylvania Electric Products. These transceivers, weighing only 11 ounces, 2½ lb with batteries, operate in the 465 mc band and have a range up to several miles

also to talk from Albany, N. Y. to Charlotte, N. C., or from Buffalo, N. Y. to St. Louis, Mo. By the middle of 1949 it will be possible to talk over coaxial lines from New York to Los Angeles via Chicago. There is a television network working from Boston, Mass. to Richmond, Va., a distance of about 600 miles, with radio relay from Boston to New York and coaxial for the remaining distance. There are dropping points at Philadelphia, Baltimore, and Washington in addition to the terminals. There is a midwestern television network connecting St. Louis, Chicago, Toledo, Cleveland and Buffalo by coaxials, with Milwaukee, Detroit and other points along the route connected in by radio relay. During the early part of 1949 these two networks will be connected by coaxial cable from Philadelphia to Cleveland via Pittsburgh, with a maximum television circuit distance of about 1500 miles.

The L1 coaxial system is capable of transmitting, on two coaxials and their associated equipments, 600 telephone circuits, or alternatively a two-way television circuit 2.8 megacycles wide. This system has presented a number of difficult technical problems. The step from the older cable carrier systems having 12 channels to a system with 600 channels was a large one and television transmission introduced additional requirements. The total cable loss for a 4000 mile circuit is about 27,000 db at the top of the transmitted band and about 4000 db at the bottom, thus requiring large amounts of gain and gain equalization.

Progress in the design of broadband amplifiers for television, radar and pulse communication is so rapid that, for a change, the engineers are ahead of the demand.[18] When electronic television came along in the early thirties, the tubes of the day permitted amplifying a band no wider than a few megacycles. Then came radar; in 1945 it was news that an amplifier having a band width of 20 megacycles had been achieved. Now, comes a new technique, called "distributed amplification" or "wave amplification." Several tubes are used in each stage, the capacitance of each tube being isolated in a separate section of the filter. In this way, the output currents of the tubes are added while their capacitances are separated, and a wholly new order of bandwith becomes possible. In one such amplifier a bandwith of 200 megacycles with 9 db gain is achieved in an amplifier using seven 6AK5 tubes in a single stage. It is indeed encouraging when the techniques thus outstrip applications. It gives the communication engineer something to think about. A 200 mc amplifier can transmit at one crack all the signals in the pre-war frequency spectrum, all point-to-point, marine, mobile services, all standard broadcast, f-m, facsimile, all television, navigation, and amateur signals. Looked at another way, a 200-mc bandwith can transmit messages at the rate of over a billion words per hour, or a ten word telegram once a day to every man, woman, and child on earth.

An interesting idea in motor control was proposed during the year[19] by N. L. Schmitz of the Cutler Hammer Co. This involved the operation of an induction motor at slow speeds in a manner analagous to that of a d-c motor supplied from a small low voltage generator. A small scale polyphase low frequency power system was built. The generators were two 1/5-hp, 32-v commutator-type machines driven by a ½-hp induction motor. The exciter was a similar 110-v commutator type machine. This combination was used to successfully "inch" and "thread" four, 1-hp, 220-v induction motors either individually or simultaneously in a model printing press drive. The experiment indicates that this method of control is feasible.

Electric Lighting

Development in the field of electric lighting if not startling continues toward the production of more efficient and longer lived units in all classes of lamps. Aside from the growing use of fluorescent lighting for general industrial service, three other classes of lamps are used for various purposes. The first of these, of course, is incandescent lighting. For most lighting — where a 6000-lumen lamp is the largest used—incandescent lighting is the only practical system. Sodium lighting has an unchallenged but limited place. For some uses its distinctive color is a "must," in others, it rules it out completely. Its low operating cost admirably suits it to applications where the color is not a factor. The mercury lamp, the newest of the three sources, definitely has its place but unlike the others, it has no field particularly its own. The basic point in applying mercury is that the smallest economical lamp produces 10,000 lumens. The mercury lamp therefore is definitely in the high-level field. Its big advantage is efficiency —double that of incandescents. Lamp cost is high, however, a factor which is partially offset by long lamp life.

A major fluorescent lamp development during the year was the development of an 85-watt lamp which produces the same high light output, maintains the same long life, and has the same dimensions as the older 100-watt lamp. Another new fluorescent lamp is complimentary to the human complexion, giving it a normal healthy appearance. The new "soft white" lamp supplements the other white fluorescent lamps.

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Gas Turbine Developments in 1948

THE GAS TURBINE made long and powerful strides, during 1948, towards its goal as our fourth stationary power plant prime mover.

During the year, one of the longest gas turbine strides was the decision to install the first commercial electric power generating gas turbine in the United States at the Arthur S. Huey Generating Station of Oklahoma Gas & Electric Co. Here a simple, open-cycle General Electric gas turbine of 4000 kw capacity, driving an electric generator, will be installed; and it will increase the station capability by 7000 kw, by utilizing the turbine exhaust heat in a Combustion Engineering Co. exhaust heat exchanger for heating water in the feedwater heating cycle of the two existing steam turbines in the station. The fuel will be natural gas. The general arrangement of the gas turbine plant is shown and further details will be presented in future issues. Engineering design of this installation is by Pioneer Service & Engineering Co., working with General Electric Co. and Oklahoma Gas & Electric Co.

A second long forward stride was taken with the announcement that the 2000-hp Westinghouse combustion gas turbine, after over 1000 hours of testing, as reported by T. J. Putz before the 1948 Midwest Power Conference, was to be shipped to Mississippi River Fuel Corp., for driving a centrifugal compressor on a natural gas line. (P. G. October, 1948)

Other strides forward were taken by the Locomotive Development Committee under the direction of John I. Yellott, towards teaching the gas turbine to burn coal. Tests of full-scale operating equipment for handling, pulverizing and burning coal and cleaning the combustion gases before they enter the turbine have been in progress for some months both at the Dunkirk, N. Y. plant of American Locomotive Works and at Fontana, Calif.

Recently the Bureau of Mines made available to the Dunkirk laboratory of LDC a large gas turbine once destined for a Houdry process in Russia under lend-lease.

One of these locomotive gas turbine plants, now being built by Allis-Chalmers Mfg. Co., was described in detail by W. B. Tucker before the ASME. It is to be an open-cycle unit designed for initial gas temperature of 1300 F, pressure ratio 4.8. With ambient air at 70 F and 14.7 psia, the unit is designed to deliver 4120-hp to the reduction gear pinion with 24 per cent shaft thermal efficiency. The turbine drives four generators.

Still another first step, on November 15 at Erie, Pa., was the beginning of track tests of the first gas-turbine-electric locomotive to be built in the U. S. This is a 4500-hp Alco-GE unit designed to burn Bunker C fuel oil.

In England, the first gas turbine for automobile drive was announced in the middle of the year at the Birmingham Industries Fair. This is a 160 br-hp unit, 5 ft long, weighing 250 lb, and burning fuel oil or other liquid fuels. It was invented by R. H. Barr and Geoffrey White.

Abroad, much work is being done by Brown Boveri, who are building two 13,000-kw, 30-per-cent-efficiency units for Beznau power house, to back up a Swiss hydro system, in addition to a number of other units for installation in Europe and South America, as reported last year.

Also, as another back-up station for a hydro system, Sulzer Bros. are building a 20,000-kw plant operating on a 1200-F high-pressure cycle, expected to have at least 30 per cent efficiency.

ATOMIC ENERGY

INTEREST in the use of atomic energy for power generation displays the same characteristic lag that has marked the progress of all great new developments.[1] True, at the present time all work in atomic research has to be conducted under the direction of the U. S. Atomic Energy Commission but this does not necessarily rule out more active participation by private interests. So far, the electric power companies of the United States have shown only half-hearted interest toward a more rapid program of development leading to the large scale generation of atomic power.

Considerable work is going on, however, under the various projects of the Atomic Energy Commission. At least two experimental nuclear reactors for use in power development are under construction, one at the Brookhaven National Laboratory on Long Island, N. Y., and another at the Argonne National Laboratory near Chicago. A third reactor is to be built at the Knolls Atomic Power Laboratory near Schenectady. While these are all experimental reactors for use in studies of reactor operation at high temperatures they will be designed so that the heat generated can be converted into electrical energy.

The operation of these reactors, will undoubtedly throw considerable light on a number of questions which are vital to the development of atomic power plants. The reactor being built at Brookhaven is to be a gas cooled unit, using helium gas as the heat transfer medium. Both gas and liquid cooling have been considered in studies on the design of these reactors and at the present time gas seems to offer greater possibilities than liquids as heat transfer media, but work on liquids is continuing. The heat transfer problem is one of the most difficult of the many problems that have to be solved before a successful atomic power plant can be built.[2]

As has been pointed out in other articles on atomic power which have appeared in these pages in previous issues, the greatest obstacle toward the development of atomic power is the general state of indifference by engineers in the power industry.

Among other gloomy predictions, the one most frequently mentioned is the limited supply of uranium. Statements have been made and widely publicized, that there is only enough uranium ore to last a relatively brief period—around 30 years. As AEC Chairman David Lilienthal pointed out on December 17, *this is simply not so.*

One of the most interesting disclosures made during the year is the possibility of producing "breeder" type of reactors.[3] A breeder reactor is one that produces fissionable material while it is developing power.

At the present time the 184-inch cyclotron at the University of California is the largest in operation but a more powerful one is being installed at the University of Chicago and during the year the AEC announced plans for a very much larger unit—a 110 *foot* cyclotron—to be built at the Radiation Laboratory at Berkeley.[4] This unit will cost about five million dollars and will take approximately five years to build.

So far, we have merely scratched the surface in the release of nuclear energy and those who maintain a pessimistic attitude towards the subject of atomic energy will do well to study the history of other great discoveries before making unwise predictions.

[1] Why Don't We Do Something About Atomic Power Development. POWER GENERATION, December 1948, p. 70.

[2] Heat Transfer and Nuclear Energy. POWER GENERATION, Feb. 1948, p. 85.

[3] The Importance of Breeding in Nuclear Power Development. POWER GENERATION, October 1948, p. 86.

[4] Military Influence On Nuclear Research. POWER GENERATION, June 1948, p. 66.

As the author of this article points out, the solvent cleaning of boilers has become increasingly important in recent years. Such methods of cleaning have not only proved extremely effective but their use had influenced boiler design to a high degree. In the first part of this article Mr. Kilsby discusses the reasons for using solvents as well as the principles involved. Then, in a second part, to be presented in a subsequent issue, he will describe the effect of these chemical methods of cleaning on boiler design

Solvent Cleaning and Boiler Design-I

By E. R. KILSBY,
Assistant Manager, Service Department, Foster Wheeler Corporation

THERE is nothing new about the necessity for keeping heat transfer surfaces clean, but there is much that is new in the cleaning problems encountered of recent years, the economic importance of cleanliness, and the costs justified in maintaining it. Output capacity and fuel economy were the chief considerations a few years ago. Those are greatly magnified today when large generating capacity, and sometimes whole stations, depend upon a single boiler. A further factor is that the fouling of one heating surface affects another and throws operations out of balance, upsets economical operation and undermines profitable performance. The problem has become a major one with the increase of pressures, temperatures and capacities of steam generating units. There is hardly a steam plant operator who has not given serious thought to reducing some phases of his growing concern about boiler cleaning—growing, because both the value of clean surfaces and the degree of cleanliness necessary, have risen in parallel with higher costs and greater premiums for availability.

The use of solvents has become increasingly accepted, in recent years, for cleaning both the water-steam sides and exterior surfaces of steam generators. "Acid cleaning" is a familiar topic of interest to most operating engineers, many of whom are either using, or considering the use of, some form of solvent cleaning. It is no longer regarded as a desperate, last resort for some incurable condition. The fact is that a high percentage of designs for new steam generating equipment assume "acid cleaning" for some portion, if not at all, of the wet side. This has spotlighted solvent cleaning generally and acid solvents in particular.

Some are old problems, others are a product of changing conditions. Some are inadvertently introduced with new plants.

The best solution for some may still be sweat and elbow grease; for

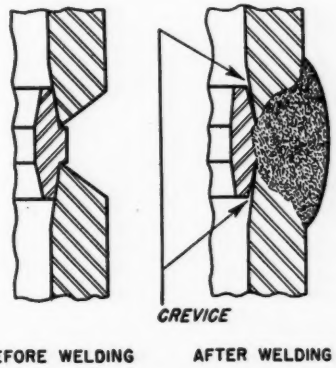


Fig. 2. Chill rings in welded joints sometimes are prohibitors of acid cleaning

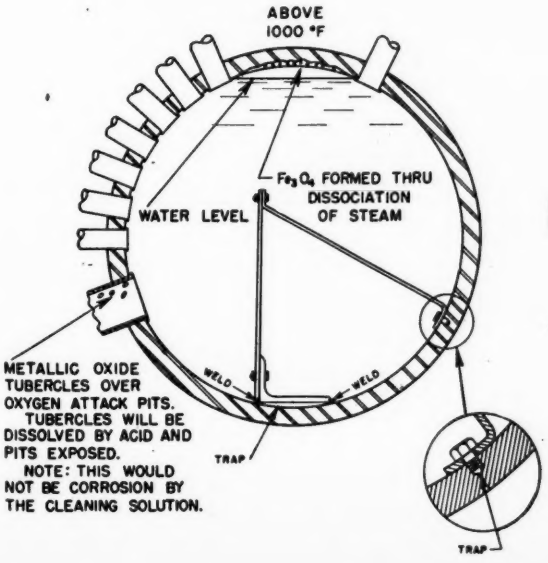

ABOVE 1000 °F
Fe_3O_4 FORMED THRU DISSOCIATION OF STEAM
WATER LEVEL
METALLIC OXIDE TUBERCLES OVER OXYGEN ATTACK PITS. TUBERCLES WILL BE DISSOLVED BY ACID AND PITS EXPOSED.
NOTE: THIS WOULD NOT BE CORROSION BY THE CLEANING SOLUTION.
WELD
WELD
TRAP
TRAP

Fig. 1. Cross section of boiler drum showing internal elements

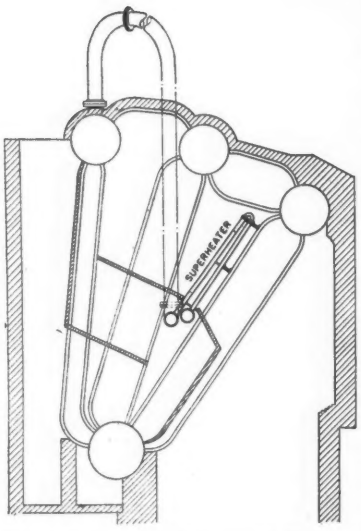


Fig. 3. Some superheaters were built of exceptionally long single loops

others plain water, a hydrocarbon, a soap compound, steam or an alkaline wash.

Reasons For Increased Use of Scale Solvents

For some years the use of boiler tubes exceeding 70 ft in length has been familiar to operators of central station or other large steaming units. It is evident that tube length, of itself, offers no thermo-dynamic limitation to designs for still higher duty with dependability. And since costs increase appreciably with each header junction, or division of tube length, the tendency in new designs is to incorporate tubes of even greater length and number of bends. Satisfactory mechanical cleaning of multi-bend tubes is, of course, most difficult. An added obstacle is that modern steam drums, through which mechanical cleaners must pass to be fed into the tubes, contain elaborate installations of baffles, washers, dryers and feed troughs, in order to secure the 1 ppm solids in steam now commonly required. The time and cost for removing and replacing these drum internals, for access to tubes, is considerable.

Among the advantages for which credit should be given to chemical cleaning is the time saved which, in some instances, has made a reduction of as much as 90 per cent of outage time. There are steam generators in the 500,000 lb per hr class that are cleaned regularly in less than 24 hr. Chemical cleaning eliminates the time for removing and replacing heat blankets, stationary heat insulators, partitions, headers and drum heads. It is frequently unnecessary to make every tube end accessible.

Furthermore, a reduction in manpower per unit of output is characteristic of the newer and larger steam generators. The staff of an old plant can often operate new boilers having several times the original capacity. Yet the man hours required for mechanical cleaning cannot be provided by them, even if the cost of prolonged outage could be tolerated. Such considerations, when imposed upon the basic essential of high internal cleanliness, are reasons for the increasingly widespread acceptance of periodic solvent, or "acid," cleaning for the interior surfaces of large boilers.

Scale prevention should be, certainly, the first line of attack. Just as obviously, there is an economic limit to provisions for obtaining water free of scale forming solids. For example, in the superheater of a 500,000 lb per hr capacity unit, one pound of solid matter, may be deposited every two hours, even though the steam contains only 1 ppm of solids. The nature of the solids, and other considerations, control the actual percentage of deposition.

Solvent Experience

All operating engineers are familiar with the use of soda ash, caustic soda, and various trade-named compounds for initial boiling out to remove oil and dirt from new boilers, or to remove oil which might enter during operation. Many are familiar with the marine practice of some years ago in which kerosene, and more recently carbon tetrachloride, was used to remove oil from internal surfaces, and to prepare long unused boilers for service.

Various hydrocarbon compounds, such as "Stoddard solutions" have been used to clean gummy or resinous deposits from internal surfaces, and there have been reports of scale dissolution during regular operation through the substitution of one compound, or chemical, for others in the boiler water.

Coke formations in the tubes of some direct fired units in which a hydrocarbon is heated, have regularly been changed to a gaseous state, following shutdown, by controlled combustion within the tubes, without tube damage. Yet those boiler operators making use of a "corrosive" acid for treating water-origin scales have been regarded, until recently, as "radicals."

Reasons For Slow Adaptation of "Acid Cleaning"

Fear and ignorance, fostered by inaccurate reports and biased opinions, have been the greatest deterrents to more rapid use of acid solvents for scale removal. Their acceptance for marine boilers is presently said to be retarded by reports of serious corrosion caused in one of several nearly simultaneous trial applications. Supposedly qualified sources attribute the corrosion to distinctly inappropriate circumstances in that instance.

There is insufficient experience as yet to justify the use of any single acid solution in all cases. Despite the fact that acid solvents have been used to clean heaters for many years, it appears best not to use acid as freely in boiler equipment known to contain interstices capable of retaining the solution, despite otherwise complete drainage. (See Fig. 1) Or where a porous, heavy, or deep oxide such as Fe_3O_4, is known to exist, firmly attached to the parent metal; or where non-ferrous metals are exposed.

The effect on internal gaskets and thin metal parts must also be considered. Ability to displace, or positively neutralize, solutions trapped in non-drainable parts, and to flush scale chips from such places, is of prime importance.

Recognition of some of these limitations has frequently led to the

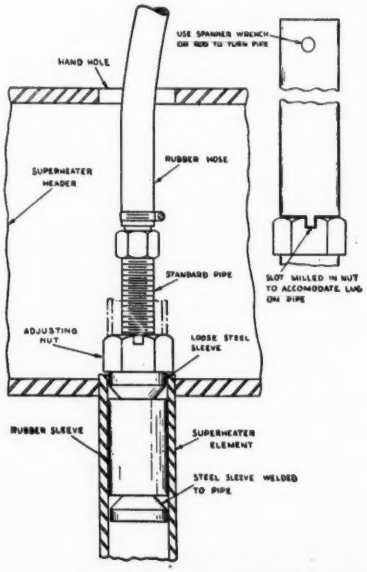


Fig. 4. Fitting for flushing superheater elements. A rubber sleeve should be placed between tapered steel sleeves

view that riveted boilers, involving buttstraps and flanges should not be "acid cleaned." Before this contention is accepted in any particular case, it might be well to consider that "where the solvent can go the neutralizer can go." The critical question would appear to be: "Can, and will, the neutralizing solution cause the solvent solution, or the gases originating in it, to be displaced?" Rolled joints, beaded tube ends, rivet heads, chill rings in welded joints (See Fig. 2), and tap bolts in drum shells, are other items sometimes cited as prohibitors of acid cleaning.

Whether the solvent, and the more corrosive gases which it generates, will be displaced depends upon such things as the effort one chooses to expand to displace it, physical limi-

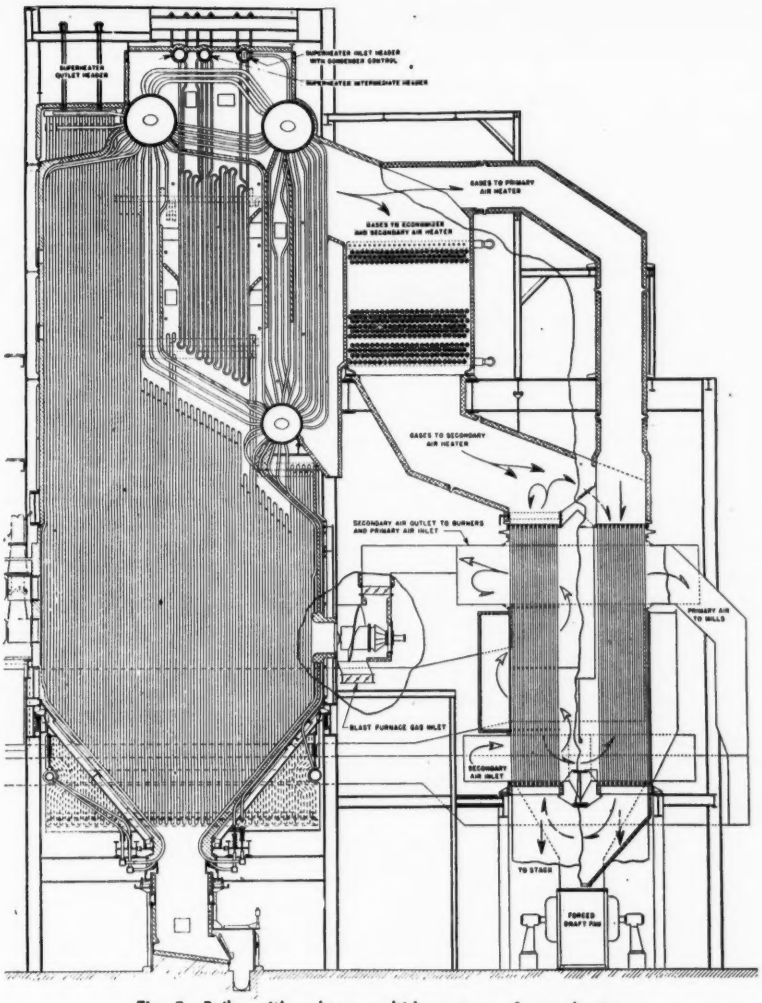

SUPERHEATER OUTLET HEADER
SUPERHEATER INLET HEADER WITH DESUPERHEATER CONTROL
SUPERHEATER INTERMEDIATE HEADER
GASES TO PRIMARY AIR HEATER
GASES TO ECONOMIZER AND SECONDARY AIR HEATER
GASES TO SECONDARY AIR HEATER
SECONDARY AIR OUTLET TO BURNERS AND PRIMARY AIR INLET
PRIMARY AIR TO MILLS
BLAST FURNACE GAS INLET
SECONDARY AIR INLET
TO STACK
FORCED DRAFT FAN

Fig. 5. Boiler with a large multi-loop type of superheater

tations, and technique employed. One helpful fact is that the boiling point of the solvent solution is usually the same, or lower than that of water; thus much of the solvent in crevices can be "flashed off" by sudden pressure release and the crevices will be refilled or washed by the neutralizing solution. Heating (and holding) the neutralizing solution to a boiling point temperature under very slight pressure for several hours, followed by sharp release of pressure through venting at several points, will usually assure displacement of trapped, solvent-origin gases, where other methods are unsuccessful.

As mentioned earlier, there are still some conditions under which acid cleaning is considered inadvisable.

Inception of Mandatory Dissolution of Internal Scale

In the early 1920's, power companies began to call for boilers capable of producing 100,000 pounds or more of steam per hour at pressures above 1000 psi and steam temperatures of 700 F. This required not only large superheaters but introduced the necessity for controlling steam pressure drop through the superheaters. A sufficiently high flow resistance, or pressure drop, was essential to effect uniform distribution of steam throughout the superheater and prevent burning out elements. However, this could not be allowed to result in main steam line pressures much below 1000 psi. These conditions limited the number of superheater tubes to be used and thereby required greater length per tube. To get the required length of individual tubes into the space available in the boiler, required that tubes be, at least, double loop instead of the former single "hairpin" loop design. Some superheaters were built of exceptionally long single loops, however, (See Fig. 3).

A mechanical tube cleaner could not be pushed upward in such tubes and, therefore, nearly 25 years ago, "acid boil-out" became necessary.

The procedure recommended for such cases, from that time to the present, has been substantially as follows:

Hydrochloric Acid Cleaning of Internal Superheater Surfaces

Use of hydrochloric acid cleaning of superheaters began experimentally in 1924. It was found that a solution 5 per cent acid, by weight, in water was adequate for all types of water-origin, solid deposits. Speed of cleaning was increased as solution temperature was increased but temperatures above 190 F were found impracticable because uniform temperature of solution throughout the superheater cannot be had except with pumped circulation, and steaming in some tubes led to excessive surging and vaporization. Further experience has brought the following present day recommendations:

1. The volume of all tubes and headers must be estimated and converted to pounds and gallons.
2. Five per cent of the weight of water which the superheater can contain is the weight of commercial muriactic grade hydrochloric acid needed. It is to be mixed with nineteen times its weight of water, in any suitable vessel. Commonly, the vessel contains the water to which the acid is added. Care, of course, is necessary to avoid splashing of concentrated acid, but the mixture is not particularly dangerous.
3. Depending upon the design and arrangement of the superheater, it may be filled in various ways. The solution may be pumped into headers through existing drain lines, or by a pipe attachment to the main steam inlet at a point below the boiler steam drum, or through the nozzle at the superheater outlet to which a safety valve is normally attached. Sometimes a vacuum line connected to a high point of the superheater is used to "pull" the mixture into the superheater through drain lines.
4. All parts of the superheater must be filled. This often requires study before filling starts to ascertain that all air has a means of escape as the solution flows into the superheater.
5. A vent (which may be a handhole opening) is desirable. It should be at the highest point of the superheater. If the superheater is of a design embodying closed loops at the highest points, these obviously cannot be vented. If the vent must be attached below the highest point in the construction, such vent should be extended upward far enough to assure no spilling of solution because of "surging" within the superheater. It should, also, be so directed as to insure no harm in the event of discharge accidentally. The principal purpose of the vent is assurance of low pressure within the superheater but a desirable secondary objective is release of steam formed.

6. Pumped circulation is preferable and should be used whenever possible. Such an arrangement should incorporate an open vessel from which air and steam can escape.

7. With the superheater completely full, a low fire is started to raise and hold the solution temperature at about 190 F. This is maintained for ten to twelve hours. Clearly, the boiler proper should contain water during this time. In some instances, a portable oil torch is used directly below the superheater to supply the required heat.

8. On completion of a ten to twelve hour period, the acid solution is displaced by water containing three pounds caustic soda and three pounds soda ash per thousand pounds of water. Frequently, the boiler steam drum is the container for this solution. When this "flushing" solution is contained in the steam drum, it is only necessary to start the normal boiler water feed supply in order to force the flushing solution into and through the superheater in large volume. The steam drum is often completely full of the flushing solution before the superheater is acid filled.

9. When displacing the acid from superheater it is essential that a high rate of flushing water flow should prevail. Chips of scale must be carried out of all elements by the velocity of the flushing water. To permit such velocity a large escape pipe is needed. This is often possible by attaching a temporary pipe to the superheater safety valve nozzle. Or, a temporary fitting may be inserted at the superheated steam outlet connection.

10. The flow of flushing water should be equal to one-half the normal steaming rate of the boiler and continued for ten minutes at least. One, completely filled, main steam drum usually contains this quantity.

11. The flushing operation should follow immediately after the ten hour period of acid content.

12. All water must be drained, or blown, from the superheater. Headers must be opened for inspection to be sure no chips have collected therein. For positive assurance of these points it is often necessary to blow out each element using compressed air. When this is done a short piece of oversize hose is held over the outlet end of the element being "blown," with the outer end of such hose led outside the header.

During the past ten years another solution has been employed where carbonates comprise a major part of the deposit to be dissolved, and hydrochloric acid is not essential, or is disliked. To wit:

Lactic Acid Removal of Internal Deposits From Superheaters

Remove all handhole plugs from both inlet and outlet headers. Fill superheater nearly full of clean, hot water. If condensed steam has already filled superheater, blow enough water from the elements with compressed air, or syphon water from each element so that space is left in the elements for the solvent solution. The compressed air line may be inserted in those legs of the elements rolled into the outlet header so that the water will flow to the steam drum or from header drains. It may be advisable to place corks or tapered wooden plugs in the legs of the elements to prevent water from finding its way back to the elements which have already been blown out. If, however, the elements are syphoned, this procedure becomes unnecessary.

The lactic acid solution should be made by dissolving 44 per cent grade acid (obtainable from wholesale drug or chemical supply houses) in water, in a steel barrel. The quantity of lactic acid used should be such that the final concentration of the solution in the superheater will be 5 per cent of the weight of water necessary to fill the superheater. After the lactic acid has been dissolved in water, distribute the solution equally in both legs of each element by using a funnel with a long stem. This is done to avoid a concentration of lactic acid on one side of the elements.

Fill the elements with clean, warm water so that the ends of the elements are submerged about a half inch in the headers.

Build a wood fire under the superheater and extending along the width of the furnace to give uniform heating of all the elements, or adjust normal firing equipment to produce a very small fire. The boiler should contain water to the bottom of gage glass. The firing should be moderate so as to heat the acid solution to a constant temperature of about 180 to 200 F for a period of 10 to 12 hr. The damper on the boiler outlet should be slightly open during this time and regulated to give the desired temperature. A thermometer may be used to determine the temperature of the solution at various points in the superheater. After heating for 10 to 12 hr, extinguish the fire and allow the superheater to cool.

Fit the inlet and outlet ends of the elements with corks or tapered wooden plugs and then flush each element individually by pumping hot, clean water

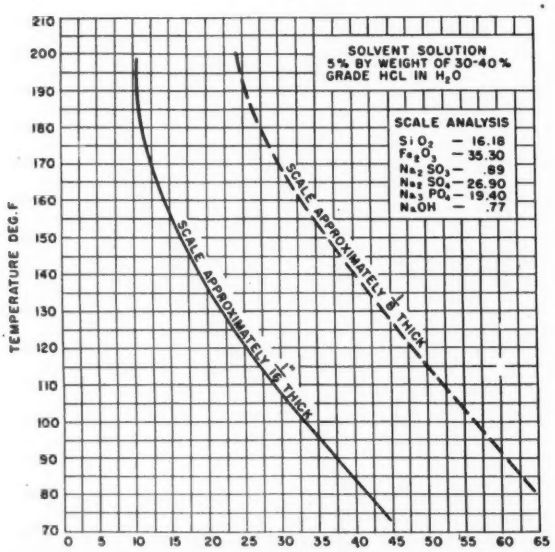


Fig. 6. Reduction in cleaning time with increase in temperature

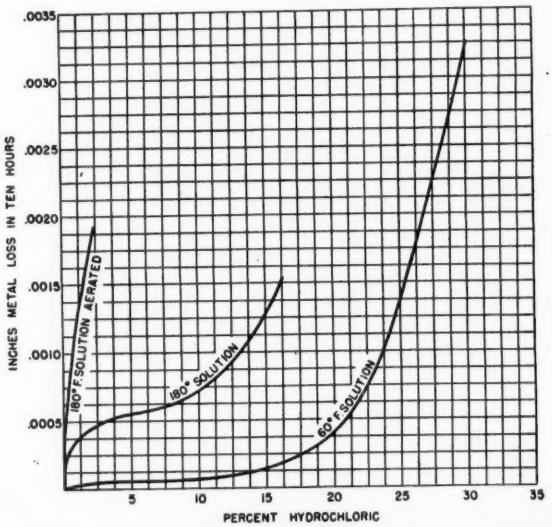


Fig. 7. Curves showing effect of temperature and entrained air

through it for 10 or 15 minutes. The water velocity should be high enough to sweep loose scale from elements. The water may discharge to the steam drum for drainage through the boiler blow-off, or through header drains. Replace wooden plugs in each element after flushing. A flushing fitting similar to those commonly used in testing radiator castings and water jackets is recommended. A rubber sleeve or rubber washers (such as those used on round gage glasses) should be placed between tapered steel sleeves. (See Fig. 4) These tapered sleves are machined to fit over a pipe, threaded at one end to accommodate a nut and hose fitting. One sleeve should be welded to the smooth end of the pipe. There should be a clearance of about 1/32 in. between the steel and rubber sleeves and the inside of the superheater tube. Tightening the top nut by hand should be sufficient to insure a firm grip of the rubber sleeve inside the tube.

If the nut is inaccessible for hand tightening, a slot should be milled across its top, as shown in the detail at the upper right portion of Fig. 4. A 1½ in. or 2 in. pipe nipple of suitable length is then machined on one end to provide lugs that will fit into the slot in the nut. This may be tightened by hand or by means of a rod placed in a hole drilled through the pipe.

If a long hose with a molded nozzle is available, this may be used in place of the flushing fitting described above. It should be wedged into the ends of the superheater elements with enough force to prevent leakage under the existing water pressure.

When all elements have been flushed, remove all the corks and replace handhole plugs, using new gaskets.

Test for plug leaks under hydrostatic pressure by using boiler feedwater pump as connected to the boiler. Close the steam stop valve and gag the superheater safety valve, also safety valves on the steam drum, if necessary.

Before returning boiler to service, fill it with water to top of gage glass, then drain down to normal starting water level by opening each blow-down valve for a short period, including those on water walls. This is done to insure removal of any lactic acid solution that may have found its way into non-draining tubes, water wall headers or other pockets during the boiling and flushing process.

It will be noted that these instructions do not call for inhibitors. But in making the individual recommendations, stress is laid on the necessity for displacement of all "acid boil-out" solution with an alkaline solution on completion of the prescribed acid contact period and, not infrequently, the heating of this neutralizing, or flushing, solution while in the superheater.

Figure 5 illustrates a large multi-loop type of superheater comparable to others for upwards of 1200 psi and 950 F, having tube sections of 4 to 6 per cent chrome, ½ per cent molybdenum, stabilized with titanium, which are cleaned by using the hydrochloric solvent. Large economizers of the type shown in Fig. 5 have also been cleaned in this general manner, and the results have been eminently satisfactory.

Use of Uninhibited 5 Per Cent Hydrochloric and Lactic Acid Solvents

The foregoing recommendations for using uninhibited HCl, or lactic acid, call for temperatures of approximately 200 F and there are several reasons for this. Among them are reduction of cleaning time (See Fig 6), minimization of air entrained (See Fig. 7), and creation of movement of solution to assist dissolution and detachment of scale "patches." It is believed, also, that silica deposits become somewhat gelatinous at one stage and the temperature, plus velocity of solution, tends to reduce adherence to metal surfaces.

The hydrochloric acid should be of the muriactic strength, i.e. 30 to 40 per cent grade; 5 per cent by weight of such acid gives a solution strength of about 1¾ per cent as used. Reference to Fig. 7 indicates the probable rate of metal loss with such solution, when clean metal is involved. However, in the application such as we have under consideration, the metal is coated by deposits which dissolve by combination with the acid elements in the formation of new, harmless solutions. Thus, the deposits reduce the 1¾ per cent acid to an even lower concentration. But disregarding this fact, the corrosion rates indicated for 5 per cent acid and clean steel, suggest a metal loss of only 0.01 in. after 20 applications.

Composition of the steel used has considerable influence upon this action, as does stress. In one case a loss of 0.0005 in. from the surface of a clean, stressed boiler tube section, submerged five hours in a 160 F solution of 5 per cent HCl was reported. It should be noted that air seems to have been present in the solution.

There have been reports of corrosion in the form of pits after acid cleaning. The cleaning technique, or conditions obtaining in these cases are unknown to the writer, but it is known that, in many cases, oxygen attack has been in progress prior to acid cleaning. The acid does dissolve the metallic film tubercle, as well as mill scale, and the product (Fe_2O_3) of oxygen corrosion, which usually fills the space under the tubercle wall. It is difficult to concede that boiler steel composition varies in a manner accountable for scattered pit type corrosion in a limited area, part or section of the boiler. Usually, two or more steel members, such as tube and drum shell, are affected in a particular region. That both of these parts should include scattered spots in the metal, of fractional inch diameter, so much more soluble than the rest that craters of measurable depth are formed through the action of the solvent solution, would seem improbable.

"Slag inclusions" are a different matter; it is most unlikely that all happen to occur in two different pieces of steel in a single zone.

Lactic acid is formed by the action of bacteria on material of sugar content. Its contact with carbonate scales reduces them to CO_2, water, and a chalky precipitate. If carbonate material is the binder, or is mixed with other material, the scale may disintegrate rather than dissolve. The tendency of lactic acid to dissolve steel is negligible in comparison with hydrochloric acid, or under the conditions with which we are concerned here. It has little effect on many of the solids normally in boiler water. The release of CO_2 might be detrimental if there are conditions under which it could be trapped. Under high temperatures, CO_2 is corrosive and the resulting product Fe_3O_4 is sometimes difficult to detect.

MIT PLANS METAL PROCESSING LAB

A NEW LABORATORY building for metals processing studies is among the projects proposed in a $20,000,000 development program announced on November 20 at the Massachusetts Institute of Technology.

More than 250 members of a Committee on Financing Development, assembled at the Institute on November 19 and 20 to consider its responsibilities and needs, recommended the $20,000,000 development program. Half of this amount is required for endowment and unrestricted funds; the balance will be used for new facilities and equipment at the Institute.

The proposed metals processing laboratory will be a four-story structure containing about 70,000 sq ft.

One of the principal units of this metals processing laboratory will be an enlarged and thoroughly modern machine tool laboratory; a major portion of the tools needed for this unit have already been secured by donation and from war surplus. The remainder of the building will provide the facilities for an integrated educational approach to fundamental manufacturing processes.

The building is estimated to cost $1,000,000 according to present plans.

Engineering Opportunities, Reheat, Gas Turbines, Controls—Featured at 69th Annual ASME Meeting

TO THE 4500 members of the American Society of Mechanical Engineers attending the 69th annual meeting of the Society held at Hotel Pennsylvania in New York City from November 29 to December 3, 1948, of outstanding interest were the sessions on reheat cycles and boilers and turbines for these cycles, instruments and the value of centralized control of power plants, recent developments in the gas turbine for stationary power plants, reports on heat transfer research to develop data useful in all power plant and industrial work, discussion of industrial use of heat from nuclear energy and emphasis on some of the long neglected problems of the small power plant and steam plant in sizes of 300 blr hp and below.

James M. Todd, consulting engineer, New Orleans, La., assumed office as the new president of the Society for 1949 succeeding E. G. Bailey, vice president of The Babcock & Wilcox Co., who served as president for 1948. Mr. Todd is a consultant in mechanical and electrical engineering, specializing in air conditioning, power plants and equipment of large buildings and factories. He was graduated from the College of Engineering of Tulane University in 1914 and received his graduate degree in Mechanical Engineering from Tulane in 1930. He is a member of Tau Beta Pi. He is recognized as an authority in the mining and production of crude sulphur.

Fig. 2. Charles G. Curtis, 88-year-old New York inventor, receives first annual award of Gas Turbine Power Division, ASME, for pioneer work in gas turbines, from Dean John T. Rettaliata, Illinois Institute of Technology, chairman of division. Mr. Curtis patented the Curtis Steam Turbine in 1896; three years later received first American patent covering complete gas turbine power plant. He is still active as president of International Curtis Marine Turbine Co., now working on a new type of marine propulsion

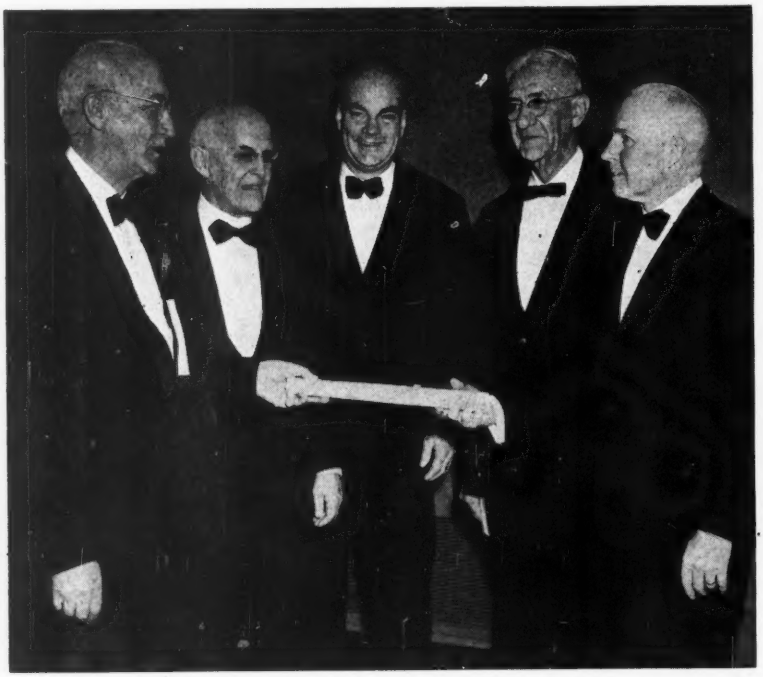


Fig. 1. Honorary Membership in ASME conferred on five men who have achieved distinction in engineering, industry, invention and education. Left to right: E. G. Bailey, President, ASME, awarding the memberships; George I. Rockwood, chairman, Board of Trustees, Worcester Polytechnic Institute; James W. Parker, president, Detroit Edison Co.; Oscar A. Leutwiler, Professor Emeritus, University of Illinois; Carl F. Braun, president, C. F. Braun and Co. Honorary Membership was also conferred on Dr. Lyman J. Briggs (not shown), Director Emeritus, Bureau of Standards

Other ASME officers entering on new terms as regional vice Presidents are: Arthur Roberts, Jr., chief engineer, Lynchburg Foundry Co.; Forrest Nagler, chief mechanical engineer, Allis-Chalmers Mfg. Co.; Carl J. Eckhardt professor of mechanical engineering and superintendent of utilities, University of Texas; and Albert R. Mumford, development engineer, Combustion Engineering Co. Directors-at-Large are Jacob A. Keeth, manager of power production, Kansas City Power and Light Co.; Ralph A. Sherman, assistant director, Battelle Memorial Institute.

Keynote of the meeting was given by Lawrence A. Appley, president of the American Management Association, at the Keynote Luncheon. Mr. Appley said the greatest satisfaction to an engineer is the realization that he is creating or assisting in creation. With American management and its conduct of the free enterprise system on trial at the bar of public opinion, survival of the system depends on management, he said, and in particular on management's ability to select and train its successors. It is nothing short of criminal to permit a young graduate engineer, said Mr. Appley, with the investment, training, development and potential he represents, to shift for himself without planned guidance and help, in the hope he will absorb or inhale what he needs to

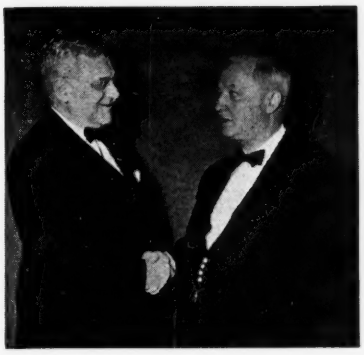


Fig. 3. James M. Todd, (right) consulting engineer, New Orleans, President of ASME for 1949, is congratulated by Clarence E. Davies, National Secretary, as he is installed in office

know or acquire about assigned work. If business men expect to find qualified hands in which to place the future of their businesses and the nation's economic health, they cannot sit back and wait for tomorrow's engineers to come knocking at their office doors. They must actively engage in their development—now.

Further on the subject of the young graduate engineer, James M. Todd, president elect, addressing the members and students luncheon, said we should endeavor to make young engineers feel, just as do the professions of medicine and law, that they have been given the same relative technical training and are to be given every merited consideration; that they are to be accepted on a professional plane of associations as having equal potentialities.

An outstanding feature of the annual meeting was the presentation to Charles G. Curtis of the first annual award by the Gas Turbine Power Division of the Society, for his pioneer work in the field of gas turbines.

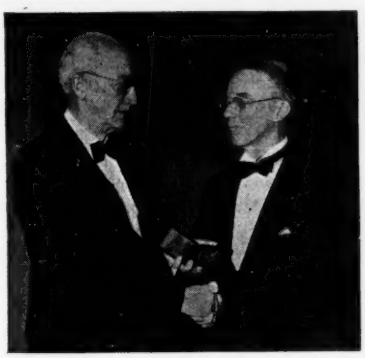


Fig. 4. Dr. Frederick G. Keyes, (right) head of department of Chemistry, Massachusetts Institute of Technology, receives ASME Medal, highest honor of the Society, from E. G. Bailey, President, at 69th Annual Meeting

Utility and Industrial Co-operation

An item of outstanding interest to the power engineers was the paper showing how co-operation in the generation and use of steam and electricity between a power utility and one or more industries can ease the industrialist's plant investment problem, lessen his construction difficulties and reduce fuel costs by furnishing more by-product power, presented by Joseph Pope, first vice president of Stone & Webster Engineering Corp., before the Society's power division luncheon. As an example of such co-operation, Mr. Pope cited the industrial area of North Baton Rouge, La. There, he said, 155 billion pounds of steam and five and a quarter billion kilowatt hours, representing the gross income of 34 million dollars, have been sold to combination customers in the last 18 years by the Gulf States Utilities Co. He outlined in detail the way in which this company and its services have developed, utilizing refinery fuel and supplying steam and electricity to a variety of refinery and chemical industries.

K. M. Irwin of Philadelphia Electric Co. then described briefly the co-operative arrangement that has been in existence for a number of years for supplying both steam and electricity from the Deepwater, N. J. station to an industrial plant of E. I. du Pont de Nemours & Co.

V. E. Estcourt, of Pacific Gas & Electric Co. then described three other co-operative plans in which the utility has built power plants to serve the Oleum, Martinez and Avon Refineries of three different oil companies in California, utilizing refinery fuels and supplying steam and electricity to the refineries.

Industrial Instruments

Interesting future for industrial instruments was indicated by E. G. Bailey, president of the Society. Mr. Bailey said that not only will the temperatures of steam and other process fluid be carried higher than those now in use, but temperatures from the combustion of fuels will undoubtedly be above those now considered possible by several hundred degrees. There will be a real problem in measuring these temperatures with the products of combustion and impurities carried therein. In addition, we will probably need to measure the flow of mixtures of gases and liquids and also an admixture of solids in suspension. There will be greater need for instrumentation applied to the chemical and physical analysis of materials in streams of flow, and from such measurements, control the composition. We will probably be called upon to measure and communicate properties or functions of materials and forms of energy be-

(Continued on page 114)

Partial list of papers of interest to Power Engineers, as presented at the 69th Annual Meeting of ASME.

The Mechanical Cleaning of Fouled Heat Exchanger Tubes; A. John—No. 48-A-114.

Heat Transfer to Water at High Flux Densities With and Without Surface Boiling; Frank Kreith and Martin Summerfield—No. 48-A-38.

Rates of Fouling and Cleaning of Unfired Heat Exchanger Equipment; J. H. Weiland, Jr., R. C. McCay, J. E. Barnes—No. 48-A-112.

Flow of Heated Gases; A. Stanley Thompson —No. 48-A-45.

An Analysis of the Heat Transfer to Turbulent Boundary Layers in High Velocity Flow; R. A. Seban—No. 48-A-44.

Heat Transfer to Liquid Metals Flowing in Asymmetrically Heated Channels; W. B. Harrison and J. R. Menke—No. 48-A-51.

Scale Formation and Control in Compression Distillation of Sea Water; John J. Campobasso and Allen Latham, Jr.—No. 48-A-115.

Cleaning Tubular Heat Exchangers; P. F. Dougherty and C. H. Brooks—Paper 48-A-116.

Fouling Rates and Cleaning Methods in Refinery Heat Exchangers; Robert C. Butler, William N. McCurdy—No. 48-A-117.

A Study of Three Tube Arrangements in Unbaffled Tubular Heat Exchangers; O. P. Bergelin, E. S. Davis and H. L. Hull—No. 48-A-34.

Corrosion of Boiler Generating Tubes at Battersea and Deptford West Generating Stations; R. L. Rees and E. A. Howes—No. 48-A-100.

Air Flow Through Small Orifices in the Viscous Region; H. R. Linden and D. F. Othmer—No. 48-A-93.

Catalytic Cracking Plants for Relieving Gas Utility Peak Loads; C. G. Milbourne—No. 48-A-101.

Errors in High Temperature Probes for Gases; E. Marston Moffat—No. 48-A-52.

Speed Regulation Computations for Hydraulic Turbines; Robert Lowy—No. 48-A-37.

A Study of the Supersonic Axial-Flow Compressor; W. A. Loeb—No. 48-A-5.

A Ventilated Thermal-Insulation Structure for High-Temperature Marine Power Plants; A. L. London and C. R. Garbett—No. 48-A-46.

Cooling Tower Analysis; Joseph Lichtenstein —No. 48-A-32.

Magnetic Particle Testing; L. B. Jones—No. 48-A-79.

Ice Making by the Extrusion Process; John R. Watt—No. 48-A-36.

Patents and the Courts—Reform or Revolution? H. A. Toulmin, Jr.—No. 48-A-49.

Machinery Installation of the "Wind" Class Coast Guard Icebreakers; Captain E. H. Thiele—No. 48-A-111.

Energy in the Engine Exhaust; Prof. P. H. Schweitzer—No. 48-A-56.

The Construction of a Revised Temperature-Entropy Chart for Air and Its Application to Explosive Combustion Studies; H. A. Everett—No. 48-A-97.

Effect of the Introduction of Natural Gas on a Highly Industrialized Territory Previously Supplied by Manufactured Gas; Paul R. Taylor—No. 48-A-41.

Elements of Graphical Solution of Water Hammer Problems in Centrifugal Pump Systems; A. J. Stepanoff—No. 48-A-89.

The Mechanical Seal-Its Construction, Application and Utility; Carl E. Schmitz—No. 48-A-70.

Torsional Viscous Friction Dampers; J. C. Georgian—No. 48-A-67.

Pipe Factors for Quantity Rate Flow Measurements with Pitot Tubes; R. G. Folsom and H. W. Iversen—No. 48-A-35.

The Collapsing Strength of Out-of-Round Vessels; Prof. R. G. Sturm and H. L. O'Brien—No. 48-A-99.

Symposium on Heat Balance Method of Testing Blowers; A. M. G. Moody, Rawleigh M. Johnson, Neal F. Lansing and Frederick G. Gilman.

Report of Graphitization Studies on High-Temperature Welded Piping of the Philadelphia Electric Company; J. B. Abele and A. E. White—No. 48-A-94.

18th National Power Show, Grand Central Palace, New York

THOUSANDS of the country's power and mechanical engineers visited the displays of nearly 400 exhibitors at the 18th National Exposition of Power and Mechanical Engineering, popularly known as the New York Power Show, held at Grand Central Palace, New York City, from November 29 to December 4, 1948. These engineers are faced with nation-wide demands for more and more steam and electric power and allied power services, also with the necessity for supplying and applying this energy to industry more and more economically because of increasing fuel and labor costs. The manufacturers of equipment represented at this Show are, of course, fully aware of these necessities and the equipment they displayed shows the results of their continuing progress in advancing power plant and industrial techniques toward greater reliability and economy.

Outstanding features of the show were widespread use of models of both complete plants and individual equipment, actual examples of fuel burning equipment, boiler auxiliaries, pumps, instruments and controls, piping and valves, mechanical transmission equipment, materials-handling equipment, engineering materials, and special machinery and tools for both maintenance and production work.

Use of Models

Power engineers were especially interested in a scale model of the new Sunbury Steam Electric Station, now under construction at Sunbury, Pa., by Pennsylvania Power & Light Co. The initial section of the station will contain four 1500-psi, 950-F steam generating units, fired with pulverized anthracite, each rated at 400,000 lb per hr, supplying steam to two 75,000-kw turbine generators. The station is designed for ultimate expansion to be the largest anthracite burning plant in the world. Completely centralized control; precipitators and I. D. fans outdoors; extraction feedwater heating cycle including two heaters integral with turbine condenser; unusual feed pump controls, and many other details are among the features.

Several manufacturers showed complete power plant models, one in particular of a 500-kw power plant demonstrating every detail of piping and valving for main units and auxiliaries.

Steam Generating Units

Although no large steam generating units were exhibited, a number of "package" or self-contained steam generating units in capacities from 10 to 300 boiler horsepower were displayed. One maker showed equipment designed for burning light oil, heavy oil and gas with quick change-over from one fuel to another. Another new design of package unit is reduced in height and length, with feedwater system separate for installation beside the unit. Another small unit was of the forced circulation once-through steam generator type for 150 psi.

In coal-burning equipment, a full-size small chain grate stoker was displayed by one manufacturer. Another maker displayed a newly-announced spreader stoker with electro-hydraulic drive, regulated through a hydraulic valve by automatic controls, and alternate pusher coal feed. Numerous well-known burners for firing oil and gas burners to boiler furnaces were also shown.

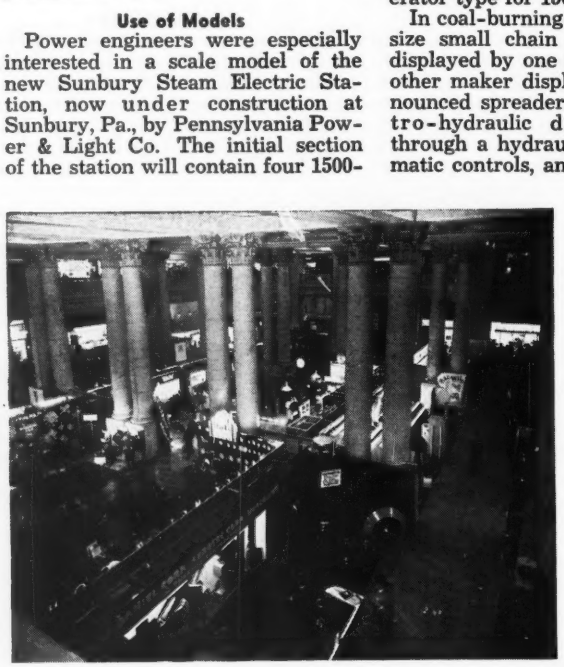


Fig. 1. General view looking down on main floor, 1948 New York Power Show

Furnace Construction

In furnace construction, one manufacturer displayed a new floating wall construction, designed to allow wall tiles on furnace water wall tubes, as well as the insulation and outside finish, to move with tube expansion. Welded stud tubes supporting the wall tile are insulated; the insulation, either of blocks or blankets, is held in position by rods and its thickness controlled by separators. The design keeps metal out of areas where metal oxidizes or deteriorates; is intended to make a steel casing unnecessary and at the same time to prevent refractory wall deterioration.

Another maker of insulation and refractories showed a new 3000-F insulating firebrick, being alternately heated and cooled rapidly. Still another had test furnaces in operation to show refractory characteristics.

Conveyor belting, and conveyor parts for coal handling systems were displayed. A permanently magnetic pulley, designed to require no outside electric power supply, for removal of tramp iron from coal or other materials in a conveying system, was shown. A diagrammatic working representation of a new automatic sequential vacuum conveying system, for automatic removal of ash from a number of hoppers, was set up in transparent piping and lights, under full automatic control.

A "zipper" type of enclosed conveyor for dry materials containing fines was displayed. This is a split rubber tube with notched edges, which is closed by a special device after loading and carries the material, entirely enclosed, to its unloading point, where the "zipper" is again opened.

Piping and Valves

Examples of prefabricated piping and piping supports as installed in new power stations were displayed. Several valve manufacturers showed various types of chrome-molybdenum steel valves in sizes up to 10 in. for pressure of 1500 psi and temperatures to 1050 F. One type is built with pressure-sealed bonnets, another has flangeless bonnet construction; all showed designs intended to reduce pressure loss, increase ease of operation and meet latest high-pressure and high-temperature requirements. Large re-

ducing valves for pressures up to 2500-psi and high temperatures were also shown. A new line of small check and globe valves in forged steel was displayed. A new steam-jacketed straight-through swing-disk valve, designed for handling viscous materials, was shown.

Cast-iron insulated pipe units built for maximum protection of underground insulated piping and for laying in a simple trench were demonstrated; also the same company's prefabricated overhead construction with the insulation wrapped in a tension spiral wrapping of aluminum or copper foil.

Water Supply and Treatment

Water supply and treatment equipment received much attention. A full-sized high-pressure feed pump with parts built of alloy to resist corrosion-erosion was on display by one maker, who also had a new design of 3-runner 2 stage condensate pump with the suction stage in the center to reduce gland troubles.

A working model of a fluid drive especially adapted to continuous speed control of boiler feed pumps was shown in an operating model.

A unit for purification of water for process, removal of bacteria and algae by ultra-violet light was displayed. Several manufacturers showed controlled volume and metering pumps for accurate introduction of small volumes of chemicals into feedwater systems and boiler drums. One new controlled volume pump has a drive unit operated by compressed air or gas, for use where electricity may not be available or convenient. Another pump proportions chemicals by a gear adjustment. Another maker demonstrated new variable-speed drive for proportioning pump and an overload release for protection against plugged lines. For feeding dry water-treating chemicals, a continuous-weighing conveyor belt device was demonstrated.

Details were given on a new sludge blanket hot process of water treatment, which has reduced silica in boiler feedwater to 2 ppm in certain plants. One manufacturer featured a continuous blowdown system and complete range of processes for water purification. A new chlorinator was demonstrated, of capacity up to 6000 lb per day, for preventing slime in cooling water circuits. New anti-foaming compounds and a treatment for eliminating sludge in fuel oil were shown by one exhibitor.

Working exhibit of an engine stop and overspeed governor for a well-known steam engine was on display. New uses of locking metal processes for repairs to equipment in place were presented by one exhibitor.

There was great interest in all instruments and controls for improving operations and efficiency and especially for help in smoke abatement. Among dust collector manufacturers were several displaying transparent models to show their devices in actual operation. One new collector consists of a large number of small aluminum elements, each whirling the gas to be cleaned so that the dust is precipitated. Another utilizes the "shave-off" principle.

Fig. 2. General view looking down on main floor, 1948 New York Power Show

Instruments and Controls

In boiler instruments and controls, there was much interest in the new oxygen meter operating on the principle of the paramagnetism of oxygen, displayed by one maker. This has application not only in measuring oxygen in boiler flue gas but also oxygen in its increasing uses in industrial processes. One maker has a new boiler water gage glass of the red-for-water, green-for-steam type, for pressures up to 1500 psi, also a new illuminator. Another manufacturer has a remote water level manometer type gage for 1500 psi showing water in white and rest of column in red, also a remote distance reading water level pointer gage with phosphorescent markings that can be read in the dark. This maker has a new gage glass illuminator consisting of an edge-wise mounted plate of lucite and a lamp that shines on the slanted edge of the lucite plate, which reflects it over the length of the column.

For rapidly measuring a number of temperatures, such as tube temperatures in a boiler, in rapid succession, recording them if desired or recording any one of them for a period, a new multipoint, multibank temperature recorder and indicator was shown by a well-known maker of instruments and controls. This will measure as many as 160 different points in rapid sequence.

Another control manufacturer had a working demonstration of a new pneumatic flow transmitter. This utilizes a force balance device combined with a shaped chamber and suitable reaction diaphragms, all built to produce an output pressure from the instrument that varies directly with flow, the latter being measured by the differential across an orifice. In short, this transmitter is designed to take the square root out of the differential measurement, thus making a uniform scale chart possible.

A new smoke density recorder on display is actuated by a bolometer that receives and measures radiation from a sealed beam light source. The light beam passes in a tube across the gas passage and smoke affects the radiation, the result being indicated and recorded by an electronic type instrument, with which an oxygen-in-flue-gas recorder can be combined if desired.

There was a new type of flow meter in which a vaned impeller is rotated by the flow, the impeller vanes interrupting a light beam and the interruptions being indicated by a stroboscopic device, which translates them into a flow measurement.

Clean dry air for operation of pneumatic instrument and control systems, air tools, and industrial processes is vital for service continuity and low maintenance. To provide it, one exhibitor showed an absorbent type dehydrator in standardized sizes and cabinet types in capacities from 150 instruments to 1000 or more.

A packaged weather control for control of heating systems, especially the new radiant heating systems, was on display.

Bevel gear universal joints, for positive transmission of torsion at angles up to 135 deg were shown, and application to unusual valve operations and other processes. A new V-belt clutch was shown, built to permit non-shock and simple clutching of V-belt drives on engine or motor drives. An all metal variable-speed transmission without belts or tubes built as extension of an induction motor, was shown.

ATOMICS

A New Section added to POWER GENERATION to cover current and forthcoming developments in atomic energy and related developments and applications in Nuclear Physics

Don't Worry About The Uranium Supply

Pessimistic views concerning our vanishing uranium supplies are groundless. Chairman of the U. S. Atomic Energy Commission, Lilienthal says such views are simply not true and that the people of the United States are entitled to know that they are not correct. The search for uranium has just begun

By Andrew W. Kramer, Editor, Power Generation

As so frequently pointed out in these pages, the pattern for the atomic power plant is quite well established. There is no mystery about the basic principle of operation of such a plant. It will consist of a nuclear reactor in which the heat of fission will be transferred to an ordinary type gas or steam turbine by means of either a gas or liquid heat transfer medium. The reactor, naturally, will be the seat of enormous quantities of radiation and it will have to be shielded and operated by remote control. Means also will have to be provided for removing the partially fissioned uranium or plutonium and for loading it with fresh nuclear fuel, all by remote control.

With the basic principles so firmly established it would seem that the actual development of atomic power plants should proceed with great vigor—that engineers and private interests would be impatient at any delay in bringing about the commercial utilization of this great new source of energy.

This, however, is not the case. At best there is only a half hearted, superficial interest among engineers in the development of atomic power. While there is general agreement that power as a by-product of reactor operation is only a few years away, the emphasis is always on the fact that the commercial feasibility of atomic power plants is still many years away. Always, the difficulty of solving the key problems is brought up and, usually, the scarcity of uranium is cited as a discouraging factor.

One wonders where this type of thinking would have led us it if had been displayed in the early days of the Atomic Bomb Project. If, after the discovery of nuclear fission by Hahn and Strassman, Fermi had been so concerned with the difficulties that lay ahead, he never would have made the journeys to Washington in 1939 to convince the military heads and others in high government circles to the development of the atomic bomb should be undertaken. It was an infinitely greater distance between the simple principle of nuclear fission and the experimental explosion of the first atomic bomb at Alamagordo on July 16, 1945 than it is between what we know now and a successful atomic power plant.

Heat Will Be Going to Waste

It took us approximately four years to develop the atomic bomb. Now, over three and a half years have passed since the bombs were dropped on the cities of Japan and, comparatively, little has been done in the direction of developing atomic power. In the meantime, thousands of millions of kilowatthours of heat energy are being wasted in reactors producing atomic weapons. As Dr. John Grebe, chemist of Dow Chemical Co. said at the recent ASME meeting in New York, a lot of high-temperature heat energy is going to be wasted in producing atomic weapons unless engineers can find ways to use it on the spot or convert it into energy forms that can be shipped and reconverted. Plentiful supplies of cheap fuels in this country, Mr. Grebe said, may hinder technological development in this field by removing economic compulsion. Other countries under the spur of compulsion may outstrip the United States in the development of atomic power plants.

Statement on Uranium Supply Not Correct

It might seem strange that the very group which should be concerned about the vanishing fuel resources—the petroleum interests—should be so concerned about the vanishing uranium supplies as they predict their depletion in a matter of 30 years. As David Lilienthal, Chairman of the U. S. Atomic Energy Commission said recently, the potentialities of the atomic age are being sold short. Statements have been made and widely publicized, that there is only enough uranium ore to last a relatively brief period, and so the prospects of benefit from atomic power must go glimmering. This, according to Mr. Lilienthal, is simply not so. It is quite clear that

atomic energy is on a sound basis for an indefinite period in the future.

Estimates of the total world supply of uranium have run from 30,000 tons to 500,000 tons, seventeen times as much. Estimates of rates of potential consumption of the fissionable material derived from uranium have also varied considerably.

"The people of the United States," said Mr. Lilienthal, "are entitled to know that these estimates of a short-lived atomic enterprise are not correct. If they were true, this would be very serious news. As explicitly as national security permits, the Atomic Energy Commission wishes to state that it finds no basis in fact for these statements about extremely limited uranium ore supplies. If this foreshortening of the atomic age were accurate, the plants and operations of the atomic energy program of the United States would have to close up in a few years. Instead, the contrary is true about uranium supplies. Estimated known reserves have already increased substantially since usefulness of uranium as a source of fissionable material became firmly established."

It must be remembered that until recent years there was very little commercial use for uranium and there was little incentive to mine it or to locate deposits of the material. Prior to the development of atomic energy, uranium was used mainly for the extraction of radium. When General McNaughton of Canada became president of the National research Council of Canada in 1935, he stated that one of his first problems was how to use the large amounts of uranium from which the radium had been extracted. This little problem seems to have been solved quite effectively now.

Look at the Facts

Suppose we look at the facts as they are available generally for making estimates such as have been publicized in recent months. It should be obvious that at present our knowledge of the amount of uranium in the world is necessarily fragmentary. Most of the published data concerning ore deposits and ore reserves is pre-war information and as indicated above before the war there was little use for uranium. A by-product of radium or vanadium ore, it was used principally as a pigment in the ceramics industry. Man has just begun to look for uranium; now, in every quarter of the earth's surface prospector's picks are breaking the rocks in this search. The current great prospecting surge may result in the discovery of new uranium deposits that will significantly alter our concept of the world supply. Some good prospects are turning up in Canada. Reports of an important uranium strike along the northeastern shore of Lake Superior started a rush of prospectors into that area early last fall. Tests showed the radioactive deposits to be around 59 per cent uranium ore.

It would be surprising if new discoveries in Canada would not, over the years, equal or better the great Eldorado mine. Only a few important discoveries would profoundly change the world supply picture.

As Mr. Lilienthal has pointed out, it is not necessary that new uranium discoveries be made in hitherto unsuspected places. One of the rules of mining is to look for new ore deposits close to known big ones. New discoveries in the Eldorado mine in Canada or in the Shinkolobwe mine in the African Congo would affect the uranium supply position of the world as profoundly as, say, one in South America—and would be reflected in production sooner.

There is another factor — good mines die hard. The comparison of measurable ore reserves with rates of consumption at any time means very little in terms of future supply. The prophets of early exhaustion of our petroleum, copper and other non-replaceable raw materials have found this out to their chagrin generation after generation.

Twenty-five years ago dire predictions were made that the rate of discovery of new pools of petroleum was not keeping pace with consumption—that the petroleum reserves would be depleted in a matter of 20 or 30 years. Yet American Petroleum Institute data have shown an annual increase in the known petroleum reserves almost every year for a decade or more despite increasing rates of production.

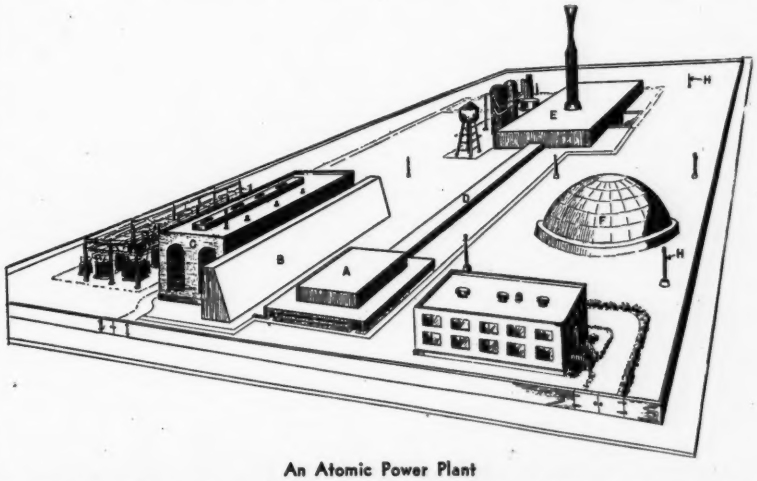
As pointed out in another article in these pages recently one factor that is not being taken into account in these pessimistic predictions about the uranium ore supply is our growing technology and its future application to low-grade sources of uranium. Most metals have gone, or are going through, a cycle where high-grade deposits are at first the only commercial deposits. Then gradually large low-grade deposits yield to man's technical ingenuity and become important producers. This cycle is strikingly demonstrated in the case of copper and lead in this country. At one time 5 per cent copper ore was essential for commercial exploitation. Now, important production comes from underground as well as from open cut mining of copper ores containing less than one per cent copper.

Furthermore, the very fact that atomic power is developed will make available large quantities of power for mining and refining purposes and this would naturally make it possible to utilize a lower grade ore.

Uranium from Oil Shale

Sweden has already announced that she plans to recover uranium from oil shales and other types of marine sediments which contain small amounts of uranium are under study in this country as in other parts of the world. One important low grade source is that announced recently by the Union of South Africa. The gold ores of the Witwatersrand contain low concentrations of uranium, and by-product uranium undoubtedly will come from the huge gold mining industry of that country.

It is well known that uranium is present throughout a large portion of the earth's crust, indeed it is estimated to be a thousand times as plentiful as gold, possibly more plentiful than lead or zinc. It is unlikely that the extremely low



An Atomic Power Plant

A. Reactor Building B. Concrete shield C. Electric Generator Building D. Conveying tunnel between reactor building and E. Chemical separation plant F. Igloo over disposal shaft G. Laboratory Building H. Radiation Detectors

grade ore will be used but the fact that uranium is not a great rarity lends credence to a geological opinion that it is likely to be present in the right place reasonably often when geological concentrating processes are at work.

At the present time the U. S. Atomic Energy Commission is responsible for one of the most extensive and intensive searches for a mineral that has ever been conducted, and on a world-wide basis. While the commission does not expect that there will be an unlimited supply there is no sound basis to believe that usable uranium ore supplies will not be available for the indefinite future.

The Atomic Energy Commission's Raw Materials program[1] which was approved last spring was predicated primarily upon the need for a thorough search in the United States for new sources of uranium. There was a possibility that important uranium deposits might be found by developing widespread interest and offering proper incentives. There was precedent for this hope; for example the stimulus given to tungsten mining during the war had resulted in important new discoveries. Therefore, the Commission established a ten-year guaranteed price for high-grade uranium ores and concentrates and a $10,000 bonus for the production of the first 20 tons of ore or mechanical concentrates from any mining claim not previously worked for uranium. The ore must average at least 20 per cent uranium oxide to be eligible for this bonus. These incentives are primarily for the discovery and production of pitchblend-type ores, the major source of the world uranium supply.

Colorado Plateau Operations

The Colorado Plateau was the only area in the United States actually producing uranium. Production came from low-grade carnotite ore mined primarily for vanadium, with uranium recovered as a by-product. During the war the Manhattan District financed the construction and operation of two plants for the extraction of uranium from tailings of Colorado vanadium plants and also purchased uranium concentrates produced as a by-product from the vanadium concentrates. Following the war it was tentatively decided by the Manhattan District to purchase only by-product uranium rather than to stimulate and support increased production by special incentives. This position was based on the fact that the known uranium reserves of the Colorado Plateau were limited and expensive to mine and process and that the only advantage of an accelerated program would be to make this limited supply available sooner. Since the estimated annual production of the Colorado Plateau, even under an accelerated program, would be small in relation to the total U. S. requirements and to supplies available from foreign sources, it appeared more economical to obtain the uranium as a by-product from vanadium operations which were geared to the vanadium market.

In undertaking a rather extensive development of the Colorado Plateau production facilities it was evident that to attain production goal, prices for the low grade Colorado Plateau ore would have to be increased to a point where the cost of uranium in the form of a high-grade concentrate would be higher than the prices being paid elsewhere. Prior to the Commissions program last April, miners were receiving about 35 cents a pound for uranium and the market for ore was limited. The Commission now pays approximately $3.50 per pound for uranium in average grade ore, including haulage and other allowances.

The current price paid by the AEC has been compared with a $5.00 per pound paid in 1918 when uranium ore was bought only for its radium content.

Under the plan initiated only 9 months ago to stimulate the uranium mining industry of the Colorado Plateau area the following results were reported by John K. Gustafson, manager of Raw Materials Operations of the AEC:

Buying schedules, guaranteeing for three years increased prices for vanadium-uranium ores have been established. An ore-buying station has been opened at the Commission-owned mill at Monticello, Utah, and the mill is being prepared for operation in 1949. Contracts for the purchase of uranium production from the two private plants now operating have been extended with provision for the purchase of ore from independent miners on terms as favorable as the Commission's schedules. Negotiations are nearing completion for contracts with private companies covering the rehabilitation and operation of the plant at Durango, Colorado and the plant at Uravan, Colorado. It is expected that before the end of 1949 all five plants in the area will be in full operation. Also private industry may build a plant in western Utah to process copper-uranium ores found in Arizona and Utah. A high-grade uranium product would be sold to the Commission.

[1] Statement of John K. Gustafson, Mgr., Raw Materials Operations, U.S.A.E.C., at Denver, Dec. 17, 1948.

FIRST GRAPHITE PUT INTO PLACE AT BROOKHAVEN ATOMIC PILE

THE FIRST BLOCK of graphite in the atomic pile at Brookhaven National Laboratory at Upton, L. I., was set into place on October 8 before a small delegation of scientists and officials representing the U. S. Atomic Energy Commission, Associated Universities, Inc., Brookhaven National Laboratory and The H. K. Ferguson Co., the engineering and building firm in charge of construction.

Signifying the start of the final phase of the construction program, the graphite block—the first of more than 60,000 that will follow—was placed into the nuclear reactor by Wilbur E. Kelley, Manager of the New York Operations Office of the U. S. Atomic Energy Commission. The ceremony was held under strict security provisions, and attendance consisted only of persons cleared by security regulations.

In an informal progress report on the Brookhaven construction program, Wells N. Thompson, Ferguson vice-president in charge of building the nuclear reactor and related facilities, disclosed that the pile will be ready to go into operation during the early part of 1949. Other structures, including the pile laboratory, a "hot" laboratory and a cyclotron building will be completed this Spring.

Among those honored in the brief ceremony in the pile structure was Dr. Lyle B. Borst, Chairman of the Brookhaven Nuclear Reactor Project, under whose supervision the pile was designed. Included in the attendance were Eldon C. Shoup, vice-president of Associated Universities, Inc.; Dr. Leland J. Haworth, Director of Brookhaven National Laboratory, and about 20 engineers and scientists directly connected with the pile project.

The Brookhaven atomic pile has been designed to serve as a research tool. It is an air-cooled graphite uranium type pile and its flexibility will enable it to perform a great number of useful research functions in the beneficial application of nuclear energy.

The blocks of graphite now being set in the pile will contain the actual chain reaction that will take place within the pile structure. In this process, the graphite serves as a moderator, and various instruments and movable strips of a neutron absorbing material are used to control the reaction.

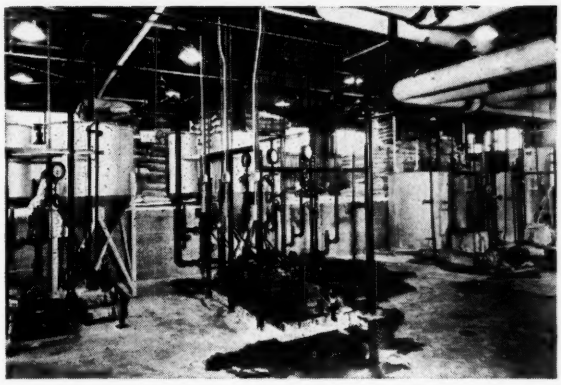


Fig. 1. View of hot process reaction tank and filters, Oakdale plant. This is part of water treatment for feedwater supply to two 75,000-lb-per-hr, 400-psi steam generating units of this new plant

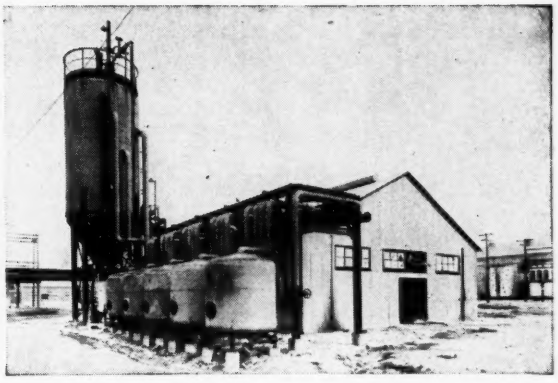


Fig. 2. View of chemical feeding and storehouse, Oakdale plant; Left—Sodium sulphate dissolving and feeding; Center—Phosphate equipment; Right—Dolomitic lime and gypsum equipment

Soft Water Hardened at Oakdale Plant of Newport Industries

WATER MAY BE just water to the layman. But many engineers regard it as a temperamental fluid of widely varying analysis and performance. As proof, they might well point to the experience of one of the newest of Southern manufacturing plants, where soft water is hardened slightly to make it fit for the boilers, yet must have its hardness tied up when it arrives there in order to make clean, dry steam and keep the boilers themselves out of trouble.

Water from two of the three plant wells supplying boiler feed water at the new Oakdale, La. plant of Newport Industries, Inc., is extremely soft. Total alkalinity may run 200 ppm as bicarbonate; 15 ppm silica; and total hardness as calcium carbonate, only 4 or 5 ppm.

Paradoxically, in the company's unusual water-treatment procedure, the soft water is put through a hot-process softener—not, however, to soften it further, but to permit treatment with hydrated dolimitic lime, to remove the silica, and with gypsum, or calcium sulphate, to reduce its alkalinity.

This out-of-the-ordinary treatment hardens the water to a degree, but produces an over-all water that can be treated successfully inside the boilers with small amounts of additional chemicals to reduce the likelihood of foaming, carryover, and caustic embrittlement, and to eliminate scale.

Field representatives of Hall Laboratories, which planned the treatment, report that the water then is filtered; pumped to a deaerating heater, where it is mixed with condensate returns; and finally is picked up by feed pumps for the two Babcock & Wilcox integral-type furnace boilers. Each boiler has a designed capacity of 75,000 lb per hr, generates at 400 psi.

Hagan phosphate—12 to 15 ppm—is pumped directly to the boilers to combine with the water hardness, now tripled, in order to prevent scale formation.

The sodium sulphite requirement has proved to be low—2 to 3 ppm—because the performance of the deaerator has been good in removing chemically any residual dissolved oxygen.

Treatment with gypsum was found to be unnecessary when water from the third well was employed during a recent period, because the supply from this stand-by source is distinctly harder than water from the first two "regular" wells and contains much less potential alkalinity.

Recent analyses of water from the three wells at this newest of Newport Industries' five plants in the South were as shown in the table.

The plant, which began operation in November, 1947, produces rosins, turpentine, dipentine and pine oil by the solvent extraction process.

Table showing analysis of well water at Oakdale, La. plant of Newport Industries, Inc.

	Well No. 1		Well No. 2		Well No. 3	
pH Value	8.7		8.6		6.3	
	ppm	epm	ppm	epm	ppm	epm
Hydroxide (OH)	0	0.00	0	0.00	0	0.00
Carbonate (CO_3)	10	0.33	8	0.27	0	0.00
Bicarbonate (HCO_3)	201	3.30	177	2.90	65	1.07
Sulfate (SO_4)	10	0.21	10	0.21	15	0.31
Chloride (Cl)	6	0.17	6	0.17	14	0.39
Silica (Si_2O_3)	10		15		40	
Iron (Fe) Total	0.78		0.42		3.7	
Calcium (Ca)	<1	0.05	<1	0.05	9	0.45
Magnesium (Mg)	<0.2	0.02	<0.2	0.02	5	0.41
Soap Hardness ($CaCO_3$) Calc.	<4	0.07	<4	0.07	43	0.86
Suspended Solids Est.	2-4		2-4		8-10	
	Hall		Hall		Hall	
a reading, ml.	0.5		0.4		0.0	
M. O. reading, ml.	10.9		9.5		3.2	

CORRECTION NOTE:— WHERE WILL ULTRASONICS FIT IN THE POWER FIELD?

IN THE ABOVE article (POWER GENERATION, September, 1948) on page 134, it was incorrectly stated that "an experimental sonic collection installation for removing fly ash from boiler flue gas has been made at the Somerset Station of Montaup Electric Co." We are advised by B. F. Hampshire, General Manager of Montaup Electric Co. that such an installation was contemplated, but for various reasons has been postponed.

The PRACTICAL ENGINEER

DEVOTED TO PLANT OPERATION and MAINTENANCE

A. W. KRAMER, EDITOR

Old Dutch Pumping Stations

A description of some interesting old pumping stations which have been in operation in Holland for over a century. Although these old steam stations are now being replaced by more modern units, some of them are still standing as monuments to commemmorate a by-gone era.

By H. WIELAND LOS, Zaandam, The Netherlands

SINCE TIME IMMEMORIAL Holland has been the land of windmill driven pumping stations. They have always formed one of the most fascinating aspects of the Dutch landscape. The number of these power plants, however, is decreasing steadily, chiefly because the general construction of these windmills has not improved or changed since the advent of the less voluminous types of prime mover, namely the steam and diesel engine.

One of the first attempts to displace the windmill was made in Rotterdam in the year 1776 where an atmospheric engine was erected in combination with eight pumps of different strokes and different diameters in order to keep the load constant when the head was changing.

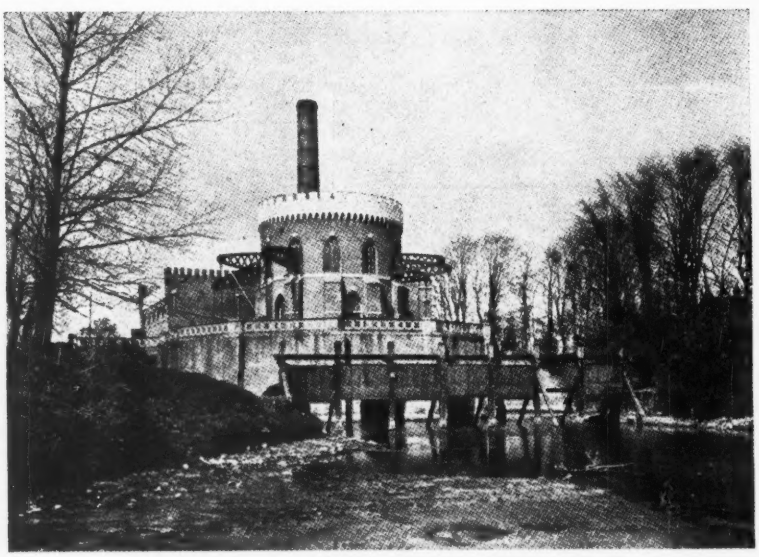


Fig. 1. One of the three pumping stations built in 1848. The piston rods of a vertical steam cylinder were connected to 8 beams extending through the walls of a circular engine room. The 8 beams were connected to 8 partially submerged pumps

This attempt resulted in failure, however, due to the excessive clearance of the pump system, a condition which entailed a considerable loss of water. The engine itself gave no trouble.

A single acting engine of Boulton and Watt was installed in this same neighborhood some twenty years later. In this installation both the engine and pump did fairly well, but since the machinery was removed to another draining place no further data was published on this particular equipment. The third enterprise of importance in this direction was to succeed; a pumping station was built at the Arkel Dam in the center of the river district in order to replace thirteen windmills.

Three double acting beam engines built by the Cockerill Company of Liege, Belgium were erected in 1826 and these were in operation until 1922. Originally, the steam pressure in this installation was 18 lb but this was later increased to 72 lb. The features of this station were embodied in other pumping plants still later on.

The next step was taken in 1848 when three stations of entirely different design were consecutively put in operation after a two century period of deliberation to drain Lake Harlem. In these stations the piston rods of a vertical steam cylinder were connected to eight beams extending through the walls of the circular engine room. The eight beams were connected respectively to eight partly submerged single-acting pumps. The engine and pumps were built by the Harvey Co., of Cornwall, England.

The steam was distributed according to the Cornish cycle as applied by Boulton and Watt in order to avoid cylinder wall condensation. In this case the low pressure cylinder and piston were arranged concentrically around the high pressure cylinder. Steam was admitted to the bottom of the high pressure cylinder with a connection also to the low pressure part above the high pressure piston and the ring-shaped low pressure cylinder.

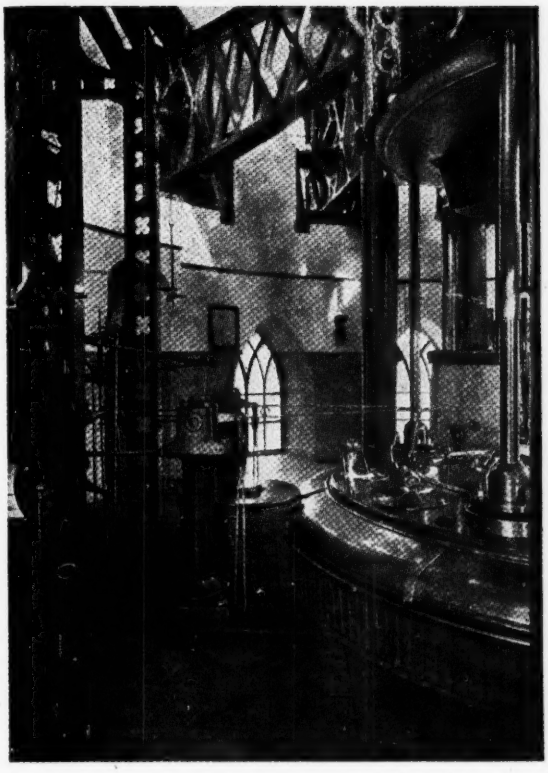


Fig. 2. Interior view of the engine room of the station shown in Fig. 1

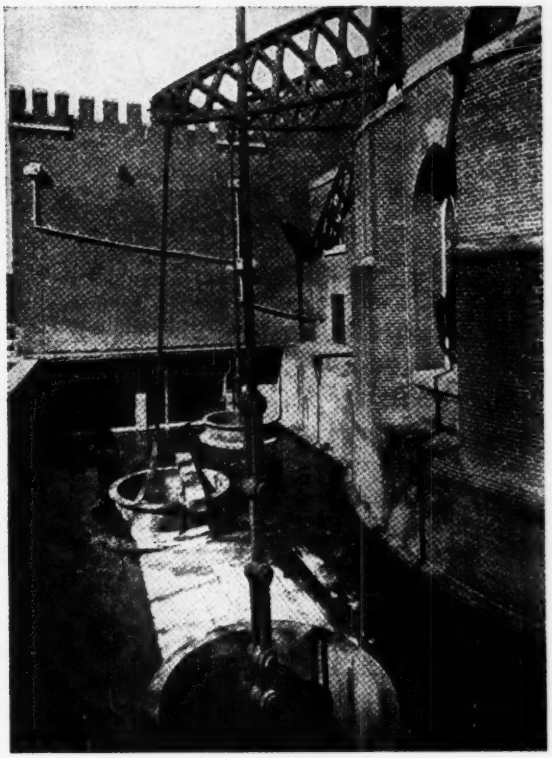


Fig. 3. A close-up showing how the beams were connected to the submerged pumps

The low pressure side was normally connected to the condenser, but the space underneath the low pressure piston was subjected to a constant vacuum.

During the upward movement of both steam pistons the eight water pump pistons were forced down thereby lifting the valves and admitting water into the pump barrels, then the steam pistons began its down stroke so that the combined weight of pistons, beams, and rods, totaling some twenty-five tons, could raise the water pistons in order to complete the cycle of operations, that is the water discharge cycle.

When the pump piston had reached the end of the down or admission stroke, the movement was retarded by means of a water cataract with a view to enable the valves to come down without a shock to their seat. Further, it was deemed imperative to lessen the number of strokes from eight to five per minute. Here are the general dimensions of the engine: Diameter high pressure cylinder 7 ft; diameter low pressure cylinder 12 ft; diameter high pressure piston rod 1 ft; diameter low pressure piston rods 0.38 ft; pump barrels 6 ft; stroke 9.8 ft; ratio, piston rod areas 2.76 to 7; hp 250; coal consumption per water horse power 3.33 lb.

One of these stations shown in the accompanying illustrations had been in operation until 1933, the last six years as a standby. It is still retained as an engineering monument. The other two stations have been stripped of their original equipment and now house combinations of heat engines and electric motors. In one

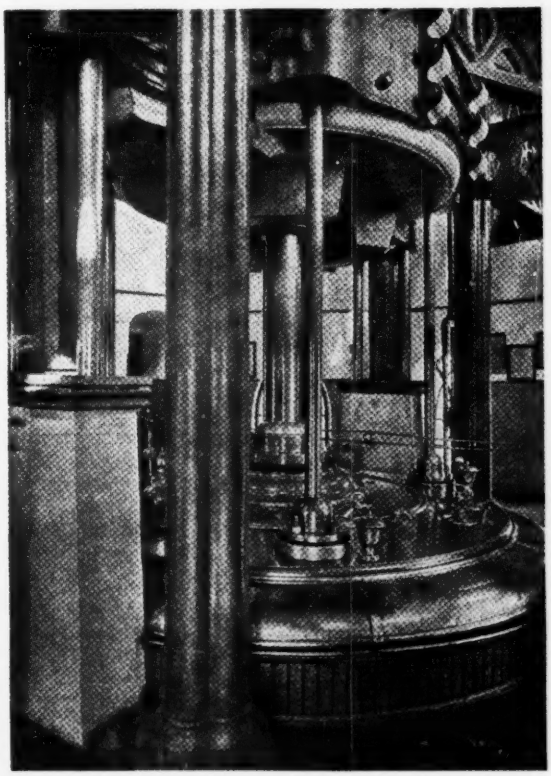


Fig. 4. Another view of the engine room showing the concentric arrangement of the high and low pressure cylinders

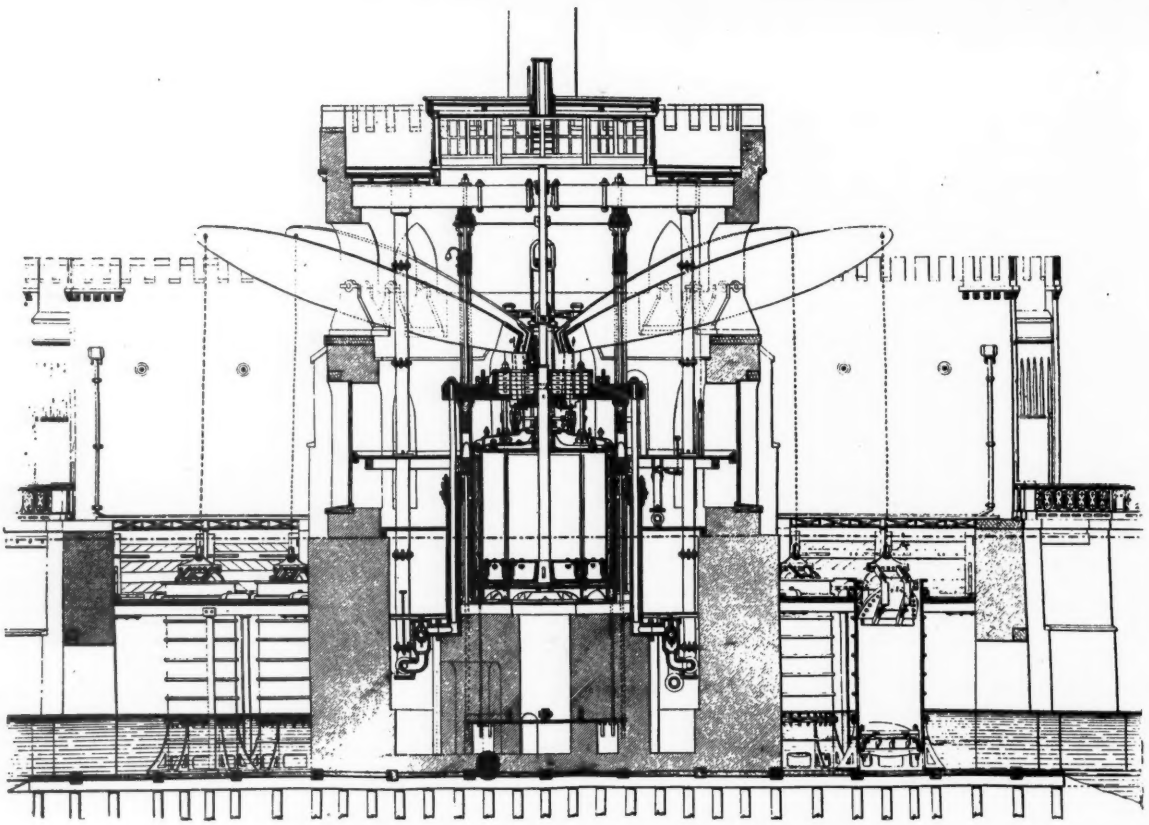


Fig. 5. Cross section through one of the 8-beam pumping stations

of these plants where in 1915 a four hundred horsepower diesel was installed the oil is now stored in the old steam boilers.

In 1857 the first of four similar stations serving the Rynland district, an area of 44,500 sq miles, was started. Three Cornwall boilers produced steam at a pressure of 45 psi for one 250 hp horizontal engine geared to two sets of three 5¾ by 24 ft scoop wheels mounted on a 14-in. cast iron shaft. The engine made 12, and the wheel 5, rpm against a head of 3.5 in. Such a station in this locality is kept in its original state save for the installation of new boilers.

It is very likely that the use factors of these old plants is coupled to certain measures of conservatism with regard to installation of modern equipment. The majority of pumping sets were originally destined to drain the lake proper, in the second place to keep the water afterwards at a predetermined level, hence, the low use factor of the old timers.

There seems to be practically no limit to the life of a low pressure steam engine as examplified by these old stations still in good operating condition.

Details of Construction

Details of one of the 8-beam pumps are shown in Fig. 5. When both pistons are in the bottom position, as shown in the drawing, steam is admitted to the central or high pressure cylinder in order to lift the combined weight if pistons, rods and ballast—a matter of 26 tons.

The steam is cut off, when the pistons have reached the end of the up-stroke. Then the steam, trapped in the high pressure cylinder is released into the space *above* the set of pistons representing the low pressure side. This low-pressure steam is expanded during the down-stroke, while the ring piston is continuously connected to the jet condenser.

The cycle is completed when the set of pistons discharge the low-pressure steam which passes the valve, on the way to the condenser. At this point the water brake already mentioned comes into action. From a water tank on the roof of the engine room, water is drawn beforehand into two plungered barrels or water cushions. The barrels are stationary, the plungers moving members as shown in the cross-section. During the reset or down-stroke, the liquid is slowly discharged through a mass of small holes and returned to the water tank on the roof after it has offered the required resistance. The general construction is plainly shown in the cross-section (Fig. 5) which is of one of the sister stations but which has a different design of the resistance offering restriction.

The steam distribution is effected by means of a movable member, actuated from the central piston rod and sliding between two machined girders (visible in Fig. 4). This part is provided with push rods, acting upon the adjacent high and low pressure valves and (across the cylinder head) the condenser inlet valve, V. Provision is made for feeding the low-pressure side with boiler steam in case of emergency.

As indicated on this diagram, the pump barrels are fitted with cast-iron, horse shoe shaped foot or inlet valves, and lifted when the plungers are raised. Raising the plungers gradually admits a charge of water until the plungers have completed their upstroke. Then the plungers start on their way down thus displacing the charge of water contained in the barrels. As a consequence, the discharge valves are lifted and water flows into the space above the plungers, to be carried away during the next upstroke.

The plungers are also of cast-iron and fit closely into the barrels without the application of any packing. The valve seats were originally composed of cross grained blocks of hard wood covered with lead strips. These materials were abandoned and successfully replaced by a one-piece rubber lining.

Reducing Waste in the Use of Low-Pressure Steam for Heating

By H. B. McDERMID

To THE MAN who has even casually studied the use of steam in heating and process work, the flagrant misuses of such mediums still often encountered seem past all belief. It was the experience of the author to run across two shining examples in the past decade that might have been excusable back in the dark ages when the world was just beginning to use steam, but which have no excuse for existence to-day—but here they were, wasting good fuel, labor, capital and good equipment, for no purpose at all. Their very existence is added proof of the strength of inertia, plain laziness and ignorance.

One plant had steam heat and process apparatus frankly in unbelievably bad shape. It was a large wood working plant operating its own kilns and making a sad bluff at heating its manufacturing plant in season. It was guiltless of any covering on pipes anywhere outside of the boiler room which had been modernized some 6 years before coming under observation.

The plant was one of a large chain, and apparently the boiler room work had been done by someone who knew what pipe covering was good for, or else it was easier to pay the covering bills than to quarrel about them—but outside the boiler room, conditions were frightful! The 8 in., 400-ft. long steam main taking low pressure or exhaust steam to the kilns, had rotted out and burst, wasting much more steam than it used; it ran under a low first floor and was buried in the earth anyway. Traps were seemingly unknown and none were in use anywhere; condensate was practically everywhere piped to the handiest sewer or run off, in some cases, through open ditches. If there was any feature that failed to be the opposite of good engineering the plant engineer failed to discover it. The boilers were largely fired with wood waste, supplemented with coal, which apparently made the management believe they were getting their heat free. When the heating system was revamped traps applied where needed the condensate piped back to the boilers, pipe covering applied as should be, the same two boilers, working no harder, developed all power for the plant (some 600 hp which previously had been purchased) and thoroughly heated some 250 per cent of the initial space heating units, besides! It took work some capital investment and proper attention to good steam distribution economies including the careful saving of all condensate. But it was merely good hardboiled engineering common sense in action and it really paid off in vastly improved heating and process services. The large plant was now comfortable all over in below zero weather when before only a few favored spots were partially heated.

In the course of time, the operating steam engineer, took a job with another wood working concern whose plant was much the same size as the first one. Here he found conditions much the same—kilns fed through a 500 ft 12 in. steam main buried out doors in wet earth across a low, badly drained yard, trying to convey steam to the kilns but succeeding only in getting very little of an end product of anything but hot water and all of the condensate was piped to the nearest sewer as quickly as possible. Similar wastefulness was prevalent all over the plant, so that three 500 hp boilers were working to their utmost capacity all the time in an effort to carry the load. By utmost capacity is not meant their normal full rated load but all the load those boilers could be forced to carry.

The old engineer remembered some of the economies the plant engineer in the previous plant had initiated and started in to follow suit. This plant was well heated, so whatever economies he was able to accomplish, soon showed up as such, as they were not instantly used up in providing badly needed additional facilities, whereas the other plant had only a poor bluff at any kind of heating, and it seemed only fair to put the savings back into added heating elements. One of his first moves was to improve the transmission of steam to the big battery of lumber kilns: his method being to build a concrete tunnel with an open top, later closed by removable covers, in which to run his steam main and condensate return lines, complete with good pipe covering, the steam line drained of unavoidable condensate. Proper traps were placed not only on this kiln system, but wherever needed all over the plant as fast as the improvements could be completed. During the process, one of the boilers gave out completely and had to be taken out but because the load had dropped, it was unnecessary even to replace it. Later as economies built up another boiler was laid by as a spare one unit proving ample to handle the load under decent conditions. Now for the first time in the history of that plant, the engineer is installing a feedwater heater! The original set-up must have been a whiz, especially when we consider that the present management is the third generation that have handled the business. It is a remarkable contrast now, to see one boiler only being fired and to know that the

Some of these plants are in unbelievably bad conditions

PRACTICAL ENGINEER SECTION

exhaust steam from one 500 kw turbine is furnishing all the heat required in the kilns and most of the additional heat required about the plant in season.

So little seems to be known by many men about the facts of ordinary steam generation that the methods of personnel selection for small plants appear pitifully inadequate. Many seem to think, even among the executive group, that because exhaust steam commonly has little pressure that even for heating purposes it has little value also so it does not matter much how you treat it. The phenomena of the latent heat of steam seems to be a sealed book to so many daily in contact with it that a quick review of the main facts about a unit of steam and the water from which it came may not be amiss. To make any discussion of the generation of steam reasonable, there had to be a unit for the measurement of heat, so the British thermal unit, or Btu was adopted. It is defined as that quantity of heat required to raise one pound of water one degree Fahrenheit. Now if we start with a pound of water at 32 deg and heat it up to the boiling point or 212 deg, we have put into it 212-32 or 180 Btu which is plain common arithmetic coupled to the definition of the Btu. Now if we go on heating the water, we find that for a very preceptible time we keep on pouring in heat that has no effect at all upon the thermometer reading, but if we watch the water we will find that it gradually turns into steam. If we accurately measure the heat input, we will find that when the entire pound of water has been converted into steam, we will have put in exactly 966 Btu over the 180 Btu used in bringing the water to the 212 deg. temperature. This is quite a lot compared to the 180 Btu required to raise the temperature from 32 to 212 deg.

Now when that steam condenses, that big chunk of heat is again released; and if we have so managed things that it is released where we want to use it, we have gone a long way toward success in our heating project. But if we allow that steam to condense in the transmission pipes on the way to its job, we have lost almost all the heat we have and have done almost nothing toward accomplishing our intention. So, our problem is, after getting our pound of water turned into steam, to get it transported without condensation (or as near that as is humanly possible) and when we get it to the proper location, condense it, and let that big gob of latent heat do its work just where and as we want it. The whole proposition can be likened to an employer sending a bank messenger to deposit $1146. If he loses $966 on the way and then finds that most of the $180 he has left from his first loss is also gone, how long do you think he would deserve a job of trust? The job of transporting steam heat is quite analagous, though it takes more skill to do it right; but it is otherwise much the same. Try always to hold that big chunk of latent heat safe until you want to use it, before you let it get away from you.

PRACTICAL HINTS AND KINKS

SHARP TOOLS SAVE LABOR; MAKE JOBS EASIER

By John G. Reynolds

EVER TRY TO bore a hole with a rusty bit? If you have, you know from experience that it takes twice as long and three times as much work as it would if your tools were always in good condition. Most every plant will find a good bench grinder with both fine and coarse stones, a wire driven brush, good files and hand honing stones indispensable for proper tool maintenance.

One example of the use of a properly equipped tool repair department may be found in a recent inspection of the axes used in our warehouse and carried on our trucks. Although their use is slight it is a policy of our company that any tool whether used frequently or infrequently deserves the best of care and our inspection revealed they were not receiving such care.

The "Super" with the whole crew on hand to listen and learn put on an exhibition of proper axe care that may be of value to you. For example we learned that axes can be best sharpened on a "wet type" grindstone. A motor driven grindstone can be used but care must be taken to avoid overheating the edge and causing it to lose its temper.

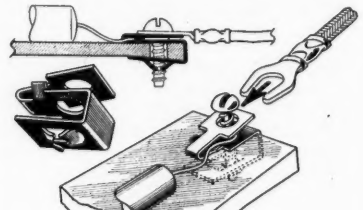
From that point on in the "Super" told us: (1) The axe should be ground more or less flat on both sides starting the grind about three inches from the cutting edge and grinding along a fan shaped area as shown in the drawing; (2) do not grind closer than within one half inch of the edge; (3) the edge of the axe should be beveled off; (4) the cutting edge should be brought down to the proper level with a special fine file in the manner illustrated in illustration so that the fan shaped portion of the axe is perfectly normal, smooth and very sharp on its edge; (5) after the axe has been reconditioned by grinding to shape and hand filing it should then be honed to a razor sharp edge.

Might take a look at the axes around your place. You may need one tomorrow and it's nice to find it ready for use.

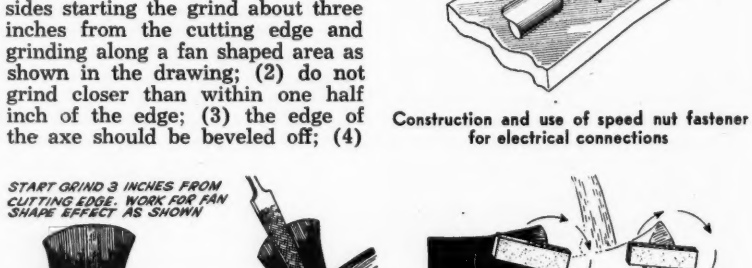
SPEED NUT FASTENER SIMPLIFIES ELECTRICAL CONNECTIONS

NEW TYPE of speed nut fastener, which eliminates the need for soldering connecting wires to lugs and at the same time provides a screw connection for leads with a spade clip, is making a right good name for itself around our plant.

As shown, the U shape of the nut slips over the terminal strip and holds itself over the clearance hole. A screw is then partially run down through the speed nut. It is now possible to slip wires in place, one



Construction and use of speed nut fastener for electrical connections


START GRIND 3 INCHES FROM CUTTING EDGE. WORK FOR FAN SHAPE EFFECT AS SHOWN
HOLD FILE LEVEL WITH THE BLADE STROKE FROM EDGE BACK TO HEAD OF AXE
RUB STONE IN CIRCULAR MOTION FROM HEEL TO TOE OF AXE. TURN AXE OVER AND REPEAT THE OPERATION

Sharpening an Axe

at a time, under the partially tightened speed nut until all are attached. The screw is then tightened only once to complete the entire connection.

Construction and use of speed nut fastener for electrical connections

Leads with spade clip are placed under the head of the screw. Single strand pigtails from capacitors and resistors are looped under the top member of the speed nut around the screw, and then positioned by the turned-up tabs at the bend. With this arrangement any one of the leads may be removed from the terminal without disturbing the others. Other advantages from the use of the speed nut are the neater appearance of the finished assembly and most important of all are the parts and time saved in making compound connections.

PRACTICAL ENGINEER SECTION

LETTERS AND COMMENTS

DOES IT PAY TO TAKE AN INTEREST IN ONE'S WORK?

By T. F. CUNNINGHAM

ASSOCIATING and talking shop with engineers of both the stationary and marine classes, I've heard many gripes about how parts and materials are so hard to get on the average job. What I can gather from all this talk is that, although the men have the interest and want to do a *good* job, it seems that some individual who has the power to buy this material and also the authority to dictate, and doesn't know the difference between a fire-tube and a water-tube boiler, can retard the good work that should and would be done if he would listen to the engineer in charge.

While on vacation, I visited one particular laundry plant where the Chief Engineer had the power to buy and to make necessary changes when he saw fit for the good of the plant in general, (this of course did not interfere in any way with operation or production.) It was a pleasure to be shown around. The Chief was one of those men from the old school of hard knocks, who got his schooling out of night school, I. C. S. courses and good trade and technical magazines. His plant was something for an engineer to be proud of—clean, everything in its place, and a place for everything.

Then I visited another small plant, which was in poor condition;—sloppy-looking pumps, boilers dirty, no standby or emergency pump in case the one feedwater pump went down. There was a low-water cut-out on this one boiler and the feed pump (electric driven) stopped due to a blown fuse. The night watchman didn't know where the switch-box was, didn't know where any fuses might be, and didn't know what the reset button on box was for. This happened the day before I made this visit. Before they could get water into the boiler, the fusible plug let go.

Also, in one particular plant where I was formerly employed, the same conditions existed as I first started out to mention. There was feedwater conditioning trouble; also, wrong packing, scored rods, liners needed on plunger ends of several pumps. Raw water make-up valve was to have been replaced two years ago and it hadn't been taken care of yet. Can't get brass polish to keep the brass clean nor paint to keep the boiler and pump rooms in first class condition. In two years time I have seen two new men arrive and after a year or so, their interest has taken a drop, so it isn't all hearsay.

I say to those in charge when you make a promise to get new parts, replacements, tools, or any necessary materials, do all in your power to keep this promise. If you can't get the necessary material, just tell the men the reason. If you don't tell them or explain why you can't get it, don't expect the men to run the job in a first class condition with second-

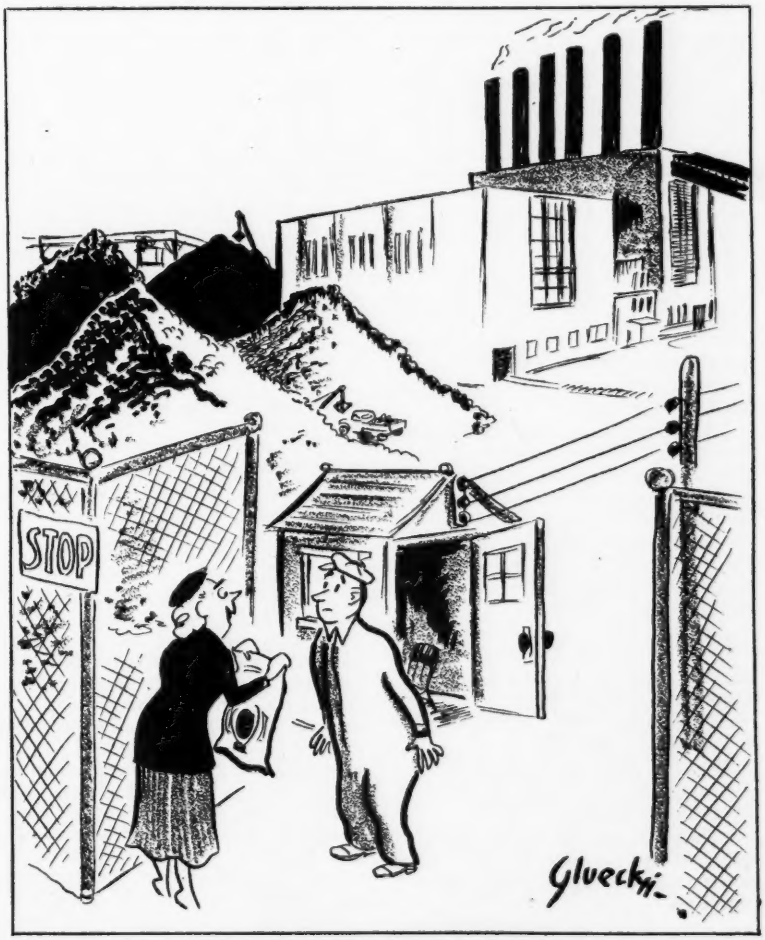
Much has been said on good housekeeping in power plants, but you'd be surprised how much it needs to be done in the average plant.

WHAT DO YOU MEAN BY THERMAL EFFICIENCY?

WHEN my JULY issue of POWER GENERATION came some time ago, I settled back in my easy chair to enjoy what looked like a swell article on Thermal Efficiency by Allen Keller of the General Electric Co.

The article looked swell for the first paragraph. But then I came to:

"Let's see why the simple definition 'efficiency equals output-over-



"I'm your neighbor down the pike, could you spare me a little handful of coal?"

input' is not satisfactory. First we will go through a few short steps of deductive reasoning in which we will derive an accurate definition of efficiency.

(1) In school the writer learned that efficiency is defined as

$$\text{Efficiency} = \frac{\text{Input}}{\text{Output}}$$

(2) In school (pre-atomic age) the writer also learned of the 'law of conservation of energy'. In accordance with this physical law, energy can neither be created nor destroyed, therefore the total energy output of any apparatus must equal the total energy input.

(3) (1) and (2) above, if taken together, indicate that the efficiency must always be 100 per cent.—This is not true.

(4) Our next thought was to change the definition of efficiency to read

$$\text{Efficiency} = \frac{\text{Input}}{\text{Useful Output}}$$

(5) This equation can also be misinterpreted and lead to an incorrect result.

I got that far—called weakly to my wife for a glass of water—and fainted! Since when has

$$\text{Efficiency} = \frac{\text{Input}}{\text{Output}}$$

been the definition of efficiency? Since when—and how—can you have complete conversion of heat energy into mechanical work?

(Editor's Note:—On page 59, August issue, a correction note explained that the numerator and denominator of this equation were accidentally transposed; they were correct on Mr. Keller's copy and our final page proof.)

I'd like to quote from the 6th edition of "Thermodynamics of the Steam Engine" published by John Wiley & Sons in 1909. The first edition was published in 1889.

The efficiency of an engine is the ratio of the heat changed into work to the entire heat applied; so that if it be represented by e,

$$e = \frac{AW}{Q} = \frac{Q - Q^1}{Q}$$

for the heat Q^1 rejected to the refrigerator is what is left after AW thermal units have been changed into work." (page 25)

Then in 1928, Millikan, Gale, and Edwards in "A First Course in Physics for Colleges" wrote

"The ratio of the useful work to the total work done by the acting force is called the efficiency of the machine."

$$\text{Efficiency} = \frac{\text{Useful work accomplished}}{\text{Total work expended}}$$

(p 197)

"The efficiency of a heat engine is defined as the ratio between the heat utilized, or transformed into work, and the total heat expended." (page 304)

But then perhaps we down here in the Ozark Hills knew the facts about efficiency all of the time. It may just be that all of this atom-smashing business has sort of softened up the brains of the experts working close to it.

Rolla, Mo. GLENN C. BOYER

After explaining to Mr. Boyer the unfortunate typographical error in the efficiency equations, we received this further comment from him:

"Mr. Keller apparently assumes in the section I quoted from his article that there is only one law of thermodynamics. Actually there are three basic laws, although engineers involved with the design and operation of power-generation equipment are only interested in the first two.

"I will agree that the first law of thermodynamics states that "heat and work are mutually convertible." I also insist that Keller should have given some consideration to the second law in his article. Emswiler and Schwartz state this second law in this fashion:

'It is impossible to transform the whole of an amount of heat, Q, imparted to a working substance, into mechanical work, in any heat engine.'

"Keller certainly used some very funny reasoning to come to the conclusion that the efficiency must always be 100 per cent. And please don't tell me that his statement that '(3) (1) and (2) above, if taken together, indicate that the efficiency must always be 100 per cent.—This is not true.' Doesn't mean what it says!

"What all this looks like to me is the old newspaper writing trick of trying to get attention."

GLENN C. BOYER

Mr. Keller's reply to Professor Boyer's comments:

I certainly agree with the last paragraph of Mr. Boyer's second letter in which he says, "What all this looks like to me is the old newspaper writing trick of trying to get attention." I think all magazine articles should be written in as interesting and attention-getting" a manner as possible.

My article was written primarily for persons concerned with the design and operation of power plants who are not quite as well informed on some of the theoretical aspects of the problem as Mr. Boyer. To such persons, the most efficient turbine is the one that will cause the station to consume the least amount of fuel. I, myself, concur in this belief. If this principle be accepted, then it follows that whenever noncondensing turbines can be used instead of condensing turbines and the total fuel consumption of a power plant thereby reduced, then the noncondensing turbines must be the more efficient type *for that particular application.*

Mr. Boyer is apparently thinking of a turbine as simply a device for generating power. This is generally true of condensing turbines. For an application which requires process steam, however, a noncondensing turbine is a device that both generates power *and supplies process steam.*

Whenever a device serves two useful functions, then I maintain that both useful outputs must be taken into account when figuring its efficiency. There is ample precedent for this viewpoint. I recall an experiment while in engineering school to measure the efficiency of a boiler feedwater injector. Now, an injector serves two useful functions; it pumps the feedwater into the boiler and it serves as a feedwater heater. The results of the test were about as follows:

Thermal efficiency of the injector as a boiler feed pump =	4%
Thermal efficiency of the injector as a feedwater heater =	96%
Total thermal efficiency .... =	*100%

(*Less a fraction of a percent for heat losses)

On this same basis, the *total* efficiency of a noncondensing turbine-generator set might be about as follows:

Thermal efficiency as a producer of electric power..... =	15%
Thermal efficiency as a supplier of process steam..... =	84%
Total Thermal Efficiency... =	99%
Mechanical, Electrical and heat losses ..... =	1%

I believe that all differences between the thinking of Mr. Boyer and myself disapper when we understand each other's definitions and terminology. Mr. Boyer may have been thinking of a power plant as a device only for the generation of electrical energy. To many of us engaged in the design and operation of industrial turbines, however, the supplying of process steam is every bit as important a function of a power plant as the generation of electricity. With this viewpoint, it is only natural that we sometimes find orthodox definitions of engine efficiency inadequate for our purpose.

In accordance with the usual definitions of efficiency, the heat of turbine exhaust steam is a loss. In an industrial plant supplying process steam, however, the exhaust of noncondensing turbines is not a loss; if this steam were not supplied by the turbine, additional fuel would need be burned in the boiler to generate it. The whole question of efficiency thus assumes a different aspect and some of the conventional definitions no longer apply.

I think it proper that I did not mention the second law of thermodynamics. As I understand this law, it says, in effect, that with ordinary

operating temperatures a thermal efficiency of 100 per cent can never be attained, or even approached closely, because there must always be a sizable loss at the turbine exhaust. But how does this apply when the station operator says, "The heat of this exhaust steam is not a loss, I want it for the factory?"—I think a discussion of the second law would further confuse the thinking of such an operator, not clarify it.

If Mr. Boyer will re-read my article, bearing in mind that it has to do with power plants, not engines, and that the printer inadvertently inverted the first two efficiency equations, then I believe most of his objections will disappear.

Lynn, Mass. ALLEN KELLER

NOTE ON THE SPEED OF LIGHT

I HAVE READ and reread the letter by Mr. Smith and the answer to the letter by the editor, A. W. Kramer, in the October issue of POWER GENERATION. The question raised in the letter is highly interesting and the answer fascinating. While they are not new I would like to contribute a few historic facts and personalities involved in the drama in the determination of the speed of light, one of the few basic, unchanging constants of nature.

Light is the fastest thing in the universe. The determination of its speed held the attention of Albert Abraham Michelson for more than a half a century. Born in Germany, 1852, he was brought to this country by his Jewish parents in 1854. In 1873 Michelson was graduated from the Naval Academy, where he became an instructor of physics and chemistry. At the age of 25 Michelson started his first experiment and at the age of 27, in 1879, he submitted his first findings to the American Association for the Advancement of Science. His figure was 186,508 miles per second.

The first investigation of the speed of light was made by the Danish astronomer Olaus Römer in 1675. He measured the lag of the reappearance of a satelite behind the planet Jupiter. His figure was 180,000 miles per second. But scientists tried to devise a laboratory method to obtain an accurate figure. By 1877 three terrestrial methods for the determination of the figure had been developed. The tantalizing problem of the speed of light occupied the minds of scientists for two centuries. Armand Fizeau in 1849 gave the figure for the velocity of light as 195,344 miles per second. Jean Foucault in 1872 gave the figure of 185,-150 miles per second.

Michelson after 1879 had determined to continue his research until he had given science an accurate figure if humanly possible. He sailed for Europe in 1880. A fundamental question in physics had to be answered. The Dutch mathematician and astronomer Christian Huygens had advanced the wave theory of light in 1678. According to this theory, luminous bodies (a lighted match) set up vibrations which travel as light waves until they strike the eye of the observer. But light could travel through vacuum. What carries the waves? And Huygens invented the scientific ghost—ETHER. Michelson set out to prove or disprove the existence of ether. Michelson proved that ether does not exist. Scientists kept on being skeptical. It was now necessary to find the meaning of absolute motion.

Two mathematical theorists independently, in 1895 suggested that ether could exist and Michelson could have gotten a zero result. George F. Fitzgerald of Trinity College, Dublin and Hendric A. Lorentz of Leyden had offered a very unusual explanation based on the electromagnetic properties of light proposed by Clerk Maxwell. Here is what they said: the length of an object actually changes when the motion of that object is increased tremendously. Mind you tremendously. A stick measuring the distance between two fixed points actually shrinks in size if it moves through space at a very great velocity along its length. According to their mathematics, a speed of 300 miles per hour would cause a shrinkage of one million millionth of one per cent. (It is obvious that it does not affect the size of an airplane

PRACTICAL ENGINEER SECTION

SUPERHEAT SPOOF

Sing a song o' sixpence then prithee tell me why
So many bozos searching for the pocketful o' rye?
They look the whole scene over in factory, shop and store,
Yet when they reach the boiler room they don't look any more.
But what the gilt attraction is I'm darned if I can see
For I've been there full many years and it's raised heck with me::
My frau's a good plant widow, says she's always second choice
While pumps and engines take my eye and make my heart rejoice.

Away back in the early days 'twas eighty-four a week
And I mean hours—not dollars—just work and eat and sleep.
Just eat and sleep and work my lad, you'd never spend a dime
On shows or high sassiety because you hadn't time::
Of course, you say, that times have changed and progress has been swift,
But whittle out a schedule once and put yourself on shift.
One week you're on the graveyard, the next you see the sun,
And then go on midafternoon, at midnight waddle home.

You won't need a white collar, just a hefty wad of waste
Your hands and nose and things will gather scads of oil and dust.
From CO_2 to performance charts, from coal pile to the stack
You trot to each emergency and meet more coming back::
I can just imagine Satan astanding at the door
With grinning stokers standing round to welcome you and more.
"It's hell, but come on in" says he, "we'll show you what is what,
You won't enjoy it much at first, but come in, the fire's hot":

And yet there's something in the game, perhaps the smell of steam,
Maybe the glint of shining brass or fire doors agleam.
It may be the thousand troubles that pursue you every minute
For every kink that's ironed out has satisfaction in it.
So you prospective boiler men take no advice from me
But give the field another look and see what you can see.
Then if still you're so inclined in spite of doubts and fears
Make up the remnants of your mind and jine the Engineers::

Bert Richards Toronto, Ont., Canada
Chief, Sunnybrook Hospital.

PRACTICAL ENGINEER SECTION

but if the speed of an object is 90,000 miles per sec., the shrinkage amounts to 13 per cent. When the speed reached 180,000 miles per second the shrinkage reaches 100 per cent. According to their mathematics matter disappears.)

Life for the physicist began to be intolerable. To answer the question of ether, velocity of light, absolute motion, invariability of mass and the relationship between energy and matter came the theory of a 26 year old Albert Einstein. There was no absolute motion and no absolute rest. Everything had to be referred to some definite framework. Motion was a relative not an absolute phenomenon. But Einstein found an exception to his rule. Speed of light is the same for all observers and does not depend on the position of the source of light.

Michelson kept on experimenting with the speed of light. During his last days and after his death 2885 determinations were made and the figure submitted is 299,774 kilometers or 186,264 miles per second. This figure will stand for many years to come. One of the most soundest constants in physical sciences.

Philadelphia, Pa. J. YAVITCH

Questions and Answers

Question No. 434

WHAT IS BEST LENGTH FOR ADJUSTABLE PISTON VALVES ON UNIFLOW ENGINE?

WE HAVE a Harrisburg uniflow engine generator, 23 by 25 in. (These engines are no longer manufactured.) It is equipped with piston valves, in which the length between pistons is adjustable to provide for different conditions of initial and exhaust pressures in different installations.

What is the best possible length at which to set these piston valves in view of the following details?

We must operate this engine for some time to come at 70 per cent of designed steam pressure. Back pressure is not important because we operate non-condensing and any back pressure produced by this engine, in excess of process heating and in excess of 2 to 4 psig, is relieved by Charlie Noble* (atmospheric exhaust).

My attempt to find the proper valve length, in lieu of a manufacturer's specification, has been: (a) to find the angular advance and then (b) to make a drawing board model of the main piston, the piston valve and the two cylinders.

From these data it was found (for four consecutively shortened valve lengths) that the engine functions are as per Tables I and II. (All functions are measured in per cent of main piston stroke).

Table II was developed because we have a spare set of valve piston follower plates over ¼ in. thicker than the normal ones. These spare plates have the effect of delaying the auxiliary exhaust by 6 per cent, at the same time advancing the point of compression by 6 per cent and reducing the kick-back by 12 per cent.

If desirable, performance data might be found beyond the range of Tables I and II: they can be extended by using the regular increments shown, until certain column items become absurd. Nine such absurd items have been marked with an asterisk.

A final note is that the main exhaust starts at 89 per cent of stroke. The term "kickback," as used here, is the interval during which the two ports between both ends of the main cylinder are open and connected via the auxiliary exhaust chamber.

Maywood, N. J. F. S.

Table I. Table of Harrisburg uniflow engine functions for various valve lengths. A is longest distance between adjustable pistons on valve, B, C, D consecutively shorter lengths. All functions in per cent of main piston stroke; * indicates absurd values

Valve length	A	B	C	D
Point of admission	8.5	11	13.5	16*
Point of cutoff	34.5	32	29.5	27
Interval of admission	26	21	16	11*
Aux. exhaust starts	63	60	57*	54*
Compression starts	78	81	84	87
Kickback	15*	20*	25*	30*

Table II. Table of Harrisburg uniflow engine functions for various valve lengths when valve pistons are equipped with follower plates ¼ in. thicker than normal. A, B, C, D are consecutively shorter distances between valve pistons. All functions in per cent of main piston stroke. * indicates absurd values

Valve length	A	B	C	D
Aux. exhaust starts	69	66	63	60
Compression starts	72	75	78	81
Kickback	3	8	13	18*

Question No. 435

WHY DID NIPPLE CAUSE SAFETY VALVE TO BLOW INCORRECTLY?

AT OUR ENGINEERS' meeting the other night, a question came up that has us all scratching our heads, including some of our boiler inspectors.

On a new boiler installation, the safety valve was received with the factory setting of 140 psi, as specified. When the boiler was finally fired up, the safety valve lifted at 75 psi. This occurred on several tries.

Then the boiler was shut down, the safety valve removed and tested against known gages, whereupon it lifted correctly at 140 psi. But on being replaced on the boiler, it again opened at 75 psi when the boiler was fired up.

The field engineer for the valve manufacturer was called. He found that a pipe nipple 12 in. long was between the boiler and the safety valve. After this nipple was removed and the valve installed directly on the boiler outlet, the valve then lifted correctly at 140 psi.

The only explanation the field engineer could give us was that the nipple caused a partial vacuum that made the valve lift at 75 psi.

Now how could there be a vacuum if there was 75 psi of steam to lift the valve? How could that nipple affect the valve operation that way? Have any other engineers ever had such an experience?

Toledo, Ohio L.T.

Answer No. 423

HOW CALCULATE CONDENSER SPRING SUPPORTS?

METHOD OF analyzing spring supports on condensers, where the condenser is bolted to and hung directly from the turbine exhaust flange, was requested by F. H. in the August issue. Although the following does not give the method of design, it does show the construction of the supports and discusses some of the factors considered in the design.

Kalman Discusses Support Details

CONDENSER SUPPORTS of this type usually consist of four sets of springs, one under each corner, to permit the condenser a certain

amount of vertical movement. The foot of the condenser shell rests on an upper plate, which is carried on six heavy helical springs, resting on the spring support plate. Adjusting screws, supplied with locknuts, pass through the spring support plate and bear on the condenser foundation bearing plate.

After the condenser has been set in place, the adjusting screws are turned down, raising the condenser to the proper height, so that it may be bolted to the turbine outlet exhaust flange. Then the locknuts are tightened. Expansion of the condenser then simply causes the springs to be compressed slightly. The alignment bolts hold the plate in alignment and their nuts are set so as to limit the upward movement of the upper plate.

In other spring-support constructions, a permanent jack is used under the spring for raising the condenser; or distance pieces may be placed under the springs after the condenser is in the proper place. Extreme care should be taken to place the correct thickness or distance pieces under the springs, and the measuring should be done when the condenser is at the proper height. The springs may be compounded; that is, they may consist of an inner and an outer spring, or they may be single. In either case, they are tested and properly marked by the manufacturer before shipment is made.

The drawing used in the installation of the condenser should show the location of the springs, their scale, free length, active length when compressed and the amount of compression when subjected to the total weight of the condenser.

If F. L. H. would like to have more information about this question, he should write to manufacturers for a set of drawings or instruction book for the maintenance and operation of their condensers.

If the condensers are installed properly, the operators have very little to do during operation, except to keep everything clean in order to prevent corrosion.

Clifton, N. J. JOHN KALMAN

Answer No. 424

WHY DESIGN B. F. PUMPS FOR SAFETY VALVE BLOW?

Comments by Brothers

I DO NOT THINK that designers are unduly conservative in figuring the discharge head of a boiler feed pump based on the maximum popping pressure of a boiler.

If the relieving capacity of the safety valves is based on the maximum evaporation of the boiler (which I believe is the best basis) without the pressure rising more than 5 per cent over the highest valve setting, surely the B.F. pump capacity and head should be calculated on the same basis.

An incident which happened to me might clarify this for E.R.C.

With three boilers on the line, supplying 450,000 lb steam per hr to the turbines, the latter were accidentally tripped, dropping the steam demand to comparatively nothing. All the safety valves raised, and, of course, the water levels disappeared. Now would be no time for the pump capacity to be curtailed. Now is the time when you need pumps of ample capacity and head, to recover your water level quickly.

In this case the pump delivered more than its rated capacity at the higher steam pressure.

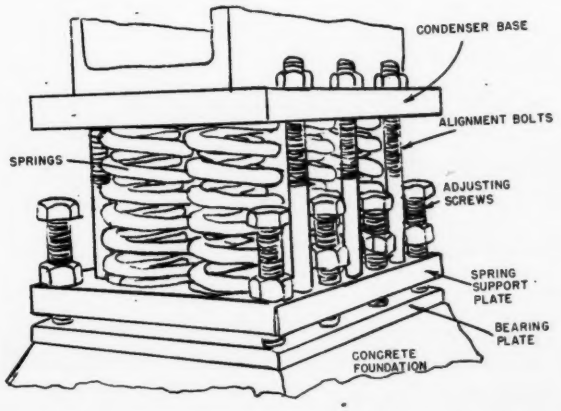
In a case of tube rupture, the need is even greater.

Reading, Ohio WILSON E. BROTHERS

Answer No. 430

WHO KNOWS ABOUT INCENTIVE BONUS SYSTEMS FOR AMMONIA REFRIGERATION PLANT?

Can an incentive bonus system be worked out for a medium-sized ammonia refrigeration plant? asked F.D. in the October, 1948, issue. The plant is part of a large factory and requires several engineers and assistants to operate it. The management wants to install an incentive bonus system for the entire manufacturing plant and desires, quite naturally, to include the refrigeration plant employees in the plan if there is any practical way of doing so.



Sketch by Kalman showing one of four sets of vertical spring supports that permit vertical movement of condenser

PRACTICAL ENGINEER SECTION

Why Should It Be Necessary to Install Such a Bonus System? asks Elbert

F.D. DOES NOT state what his corporation manufactures, therefore it is very hard to offer a direct suggestion, but perhaps the following will be helpful.

If it is an ice plant, a bonus could be paid on the amount of ammonia used per ton, or tons of ice produced.

If it is a storage plant, a bonus corld be paid on the amount of ammonia used in comparison to the amount of storage; or on keeping the proper temperatures in the rooms, in comparison to the amount of spoilage.

These are only two of the many ways in which a wage incentive system could be worked out, but—why should it be necessary to install a wage incentive system?

A man employed as chief engineer of a refrigerating plant must of necessity have a background which qualifies him for such a position. He must possess the necessary licenses from the State Board of Examiners and also have the time and experience necessary to hold the position of Chief Engineer.

As the head of his department, he automatically assumes the responsibility for his department, also the employing of competent help or assistants.

The manufacturer of the machinery installed in the plant has a chart or graph showing the efficiency of each machine and it is the Chief Engineer's duty to try to equal that set of efficiencies.

Safety and outage are also items vitally important to the Chief Engineer. Safe working conditions for the personnel and good housekeeping are both factors which improve personnel morale.

A man in taking charge should have the wholehearted co-operation of the management, which in turn is reflected through the Chief Engineer to the plant personnel. This leads to a harmonious condition, which is worth many times the amount that may be paid as a bonus.

There is also the feeling a man has, in assuming a responsible position, of doing a good job, pride in his ability and the trust shown in him. It is very obvious, the proper man with the necessary qualifications should not have to be goaded by a wage incentive plan.

A bonus plan at best is very poor management. Efficient and safe operation of the plant is the first consideration of an engineer who takes pride in his work.

Irvington 11, N.J. CHARLES H. ELBERT

Temperature Conversion Tables

—100 to 95						96 to 1100					
C.		F.	C.		F.	C.		F.	C.		F.
—73.3	—100	—148	6.11	43	109.4	35.6	96	204.8	304	580	1076
—67.8	— 90	—130	6.67	44	111.2	36.1	97	206.6	310	590	1094
—62.2	— 80	—112	7.22	45	113.0	36.7	98	208.4	316	600	1112
—56.7	— 70	— 94	7.78	46	114.8	37.2	99	210.2	321	610	1130
—51.1	— 60	— 76	8.33	47	116.6	37.8	100	212.0	327	620	1148
—45.6	— 50	— 58	8.89	48	118.4	38	100	212	332	630	1166
—40.0	— 40	— 40	9.44	49	120.2	43	110	230	338	640	1184
—34.4	— 30	— 22	10.0	50	122.0	49	120	248	343	650	1202
—28.9	— 20	— 4	10.6	51	123.8	54	130	266	349	660	1220
—23.3	— 10	14	11.1	52	125.6	60	140	284	354	670	1238
—17.8	0	32	11.7	53	127.4	66	150	302	360	680	1256
—17.2	1	33.8	12.2	54	129.2	71	160	320	366	690	1274
—16.7	2	35.6	12.8	55	131.0	77	170	338	371	700	1292
—16.1	3	37.4	13.3	56	132.8	82	180	356	377	710	1310
—15.6	4	39.2	13.9	57	134.6	88	190	374	382	720	1328
—15.0	5	41.0	14.4	58	136.4	93	200	392	388	730	1346
—14.4	6	42.8	15.0	59	138.2	99	210	410	393	740	1364
—13.9	7	44.6	15.6	60	140.0	100	212	413	399	750	1382
—13.3	8	46.4	16.1	61	141.8	104	220	428	404	760	1400
—12.8	9	48.2	16.7	62	143.6	110	230	446	410	770	1418
—12.2	10	50.0	17.2	63	145.4	116	240	464	416	780	1436
—11.7	11	51.8	17.8	64	147.2	121	250	482	421	790	1454
—11.1	12	53.6	18.3	65	149.0	127	260	500	427	800	1472
—10.6	13	55.4	18.9	66	150.8	132	270	518	432	810	1490
—10.0	14	57.2	19.4	67	152.6	138	280	536	438	820	1508
— 9.44	15	59.0	20.0	68	154.4	143	290	554	443	830	1526
— 8.89	16	60.8	20.6	69	156.2	149	300	572	449	840	1544
— 8.33	17	62.6	21.1	70	158.0	154	310	590	454	850	1562
— 7.78	18	64.4	21.7	71	159.8	160	320	608	460	860	1580
— 7.22	19	66.2	22.2	72	161.6	166	330	626	466	870	1598
— 6.67	20	68.0	22.8	73	163.4	171	340	644	471	880	1616
— 6.11	21	69.8	23.3	74	165.2	177	350	662	477	890	1634
— 5.56	22	71.6	23.9	75	167.0	182	360	680	482	900	1652
— 5.00	23	73.4	24.4	76	168.8	188	370	698	488	910	1670
— 4.44	24	75.2	25.0	77	170.6	193	380	716	493	920	1688
— 3.89	25	77.0	25.6	78	172.4	199	390	734	499	930	1706
— 3.33	26	78.8	26.1	79	174.2	204	400	752	504	940	1724
— 2.78	27	80.6	26.7	80	176.0	210	410	770	510	950	1742
— 2.22	28	82.4	27.2	81	177.8	216	420	788	516	960	1760
— 1.67	29	84.2	27.8	82	179.6	221	430	806	521	970	1778
— 1.11	30	86.0	28.3	83	181.4	227	440	824	527	980	1796
— 0.56	31	87.8	28.9	84	183.2	232	450	842	532	990	1814
— 0	32	89.6	29.4	85	185.0	238	460	860	538	1000	1832
0.56	33	91.4	30.0	86	186.8	243	470	878	543	1010	1850
1.11	34	93.2	30.6	87	188.6	249	480	896	549	1020	1868
1.67	35	95.0	31.1	88	190.4	254	490	914	554	1030	1886
2.22	36	96.8	31.7	89	192.2	260	500	932	560	1040	1904
2.78	37	98.6	32.2	90	194.0	266	510	950	566	1050	1922
3.33	38	100.4	32.8	91	195.8	271	520	968	571	1060	1940
3.89	39	102.2	33.3	92	197.6	277	530	986	577	1070	1958
4.44	40	104.0	33.9	93	199.4	282	540	1004	582	1080	1976
5.00	41	105.8	34.4	94	201.2	288	550	1022	588	1090	1994
5.56	42	107.6	35.0	95	203.0	293	560	1040	593	1100	2012
						299	570	1058			

NOTE—The numbers in bold face type refer to the temperature either in degrees Centigrade or Fahrenheit which it is desired to convert into the other scale. If converting from Fahrenheit degrees to Centigrade degrees the equivalent temperature will be found in the left column, while if converting from degrees Centigrade to degrees Fahrenheit, the answer will be found in the column on the right.

INTERPOLATION FACTORS

C.		F.	C.		F.
0.56	1	1.8	3.33	6	10.8
1.11	2	3.6	3.89	7	12.6
1.67	3	5.4	4.44	8	14.4
2.22	4	7.2	5.00	9	16.2
2.78	5	9.0	5.56	10	18.0

Reprinted by Courtesy W. C. Hardesty Co., Inc.

Take a *good* look at a *Liability*

Any boiler plant becomes a liability when improper water conditioning eats up profits by causing excessive blowdown, carryover . . . scale.

But this liability can be turned into an asset with *correct* water conditioning . . . a matter of careful and scientific control.

W. H. & L. D. BETZ is an organization of engineers and chemists specializing in the solution of all industrial water problems. Years of experience have made Betz water conditioning service scientifically correct . . . complete . . . economical. Our staff of engineers will welcome the opportunity of discussing your boiler water problems . . .
W. H. & L. D. BETZ, Gillingham and Worth Sts., Philadelphia 24, Pa.
In Canada: Betz Laboratories Limited, Montreal 1.

BETZ

BOILER WATER CONDITIONING • COOLING WATER CONDITIONING • INDUSTRIAL WASTE TREATMENT

Details of New F&E Spreader Stoker

THE SPREADER STOKER recently announced by the Flynn & Emrich Co. is designed to burn all grades of bituminous coal and is intended primarily for firing large industrial boilers. Features of the stoker are its electro-hydraulic drive, its alternate coal pusher feeders, its design for accessibility.

The electro-hydraulic drive, housed in one casting, is designed with a minimum of working parts—all of them completely encased and operating in a bath of oil.

The electric motor or steam turbine, as the case may be, (or both, if dual drive is required) supplies power through a helical gearpump for hydraulically operating the coal pushers. This same motor, or steam turbine, also supplies power direct to the distributor line shaft from which each distributor is individually driven, with variable speed pulleys to permit adjustment of distributor speed.

The electro-hydraulic drive employs a reciprocating action to oscillate the coal pusher line shaft, which connects individually with the coal pushers.

Regulation of the operation of the electro-hydraulic drive is by means of an incremental hydraulic control valve. This valve controls the coal feed by regulating the oil supply to the hydraulic cylinder, either through manual or automatic control.

The alternate pusher coal feeder has coal pushers of the step design, built to cover the entire area of the hopper bottom. These pushers are generally made up of four sections and are continuously in motion; while two sections of pusher are advancing two other sections are receding, to keep the coal feeding constantly onto the revolving distributors and prevent bridging.

Each coal feeder may be adjusted to any feeding capacity required and the feed from any hopper instantly discontinued, if required, without disturbing the feeding operation of the other hoppers.

Because of the hydraulic drive that powers the coal pushers, no shear pins or other devices are provided. The coal distributors are mounted in water-cooled ball bearings, operate in an overthrow direction, and their speed and the trajectory of coal discharge into the furnace may be regulated while the stoker is in operation.

The distributor cases are air-cooled and provide for admission of secondary air immediately over the revolving distributors. Ventilated sections above and below the distributors provide a means for cooling these parts.

Grate surfaces are of stationary or dumping grate design. The dumping grates are either manually operated or power operated—the latter by pressure cylinder—using either air or steam pressure.

The grate bars are sectional in design, having deep cooling ribs beneath the deep grooves on top for protective ash accumulation. Individual grate sections are mounted on heavy steel carrier bars.

Controlled overfire air and correctly placed steam jets are carefully engineered to give a proper turbulence pattern for each individual installation, to insure efficient combustion and reduce fly ash leaving the furnace to a minimum.

The stoker has been designed and constructed with a view to ready accessibility of all working parts. The electro-hydraulic drive is mounted on the side panel high off the floor, is self-contained and completely accessible. Pusher crank assembly is completely exposed by removal of cover. Coal distributors may instantly be reached by dropping the hinged segment of the distributor casing to permit immediate removal of tramp iron or other obstructions. The coal hopper can be quickly emptied with distributor case opened and trajectory plate withdrawn to its full backward position.

Phantom view of new F & E spreader stoker, showing electro-hydraulic drive and feeder mechanism

NEW STOCKING-OUT CONVEYOR FOR CAHOKIA

AT CAHOKIA Power Station of Union Electric Co., St. Louis, Mo., the coal-handling system has recently been amplified by the addition of a conveyor system for handling coal through a tunnel underground from an outdoor reclaim hopper into which the apron conveyor from the car dumper hopper delivers its coal; and for conveying coal from the bottom of the collecting hopper to an initial pile in the storage yard.

Cahokia Station burns pulverized coal, consumes normally about 80 carloads or 4500 tons of coal per day. The coal-handling system, including car-dumper, coal breakers and necessary feeding and conveyors, was installed when the first section of the station was completed in 1923, and was designed for extension to serve the station as it expanded to its present capacity of 300,000 kw. The new stocking-out system equipment has been supplied by Link-Belt Co.

The reclaim hopper is located under outermost railroad track and therefore permits receiving coal directly from hopper-bottom cars as well as from the tractor-drawn LeTourneau Carryalls employed for

scooping up coal from the storage yards and hauling it to reclaim hopper.

The reclaim hopper measures 14 by 18 ft in plan, and its mouth is provided with a safety grating, which excludes any large extraneous materials. This grating had to be made strong enough to sustain tractor-load or the Carryall loaded with 11 to 13 tons of coal.

Two tractor-drawn, 18-cu-yd carryall units (14.2 yd struck measure) are employed for reclaiming coal from storage. Records show that as much as 800 tons had been reclaimed with each unit in an 8 hr day, based on a one-way haul of about 600 ft.

The entire coal handling system is very versatile, and it will be noted from the foregoing that coal unloaded by L-B Rotary car dumper, or coal received through reclaim hopper, can be conveyed to breaker No. 1 or No. 2 and then to the various overhead storage bunkers inside power plant, or to the storage yard for reclamation at a later date.

The recently installed reclaiming and stocking-out conveyors, each employing a 36-in. wide conveyor belt, operating over roller-bearing Type "100" conveyor idlers, have a contract handling capacity of 500 tons per hour. Self-aligning idlers located at suitable intervals automatically keep the conveyor belt central, without injury to belt edges.

This conveyor starts in a tunnel underground and rises at an inclination of 14 deg to a height of 24 ft above storage ground. The drive for this conveyor, located at head end, consists of an electric motor with enclosed herringbone-gear speed reducer connected to head shaft by Silverlink roller chain. A telescoping chute, adjustable by means of a hand winch, permits discharge of coal from a point only 6 ft above ground, if desired.

The entire outdoor portion of conveyor is protected from the elements by a curved, corrugated aluminum hood, with every other panel made removable.

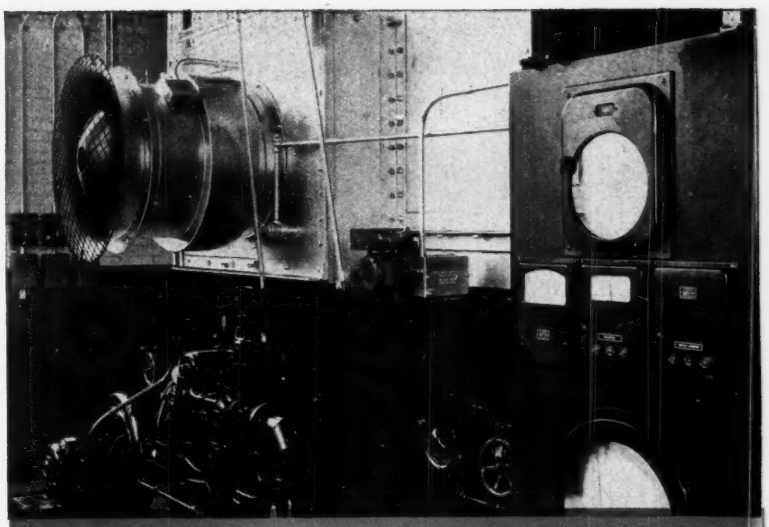
Conveyor is mounted on a steel structure and has a walkaway with pipe handrailing along one side from ground to head end, for convenient access to any portion of conveyor and to the driving machinery at head end.

Other Features

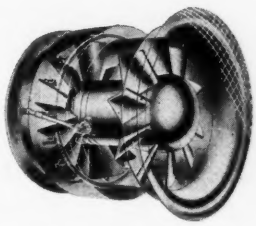
Other features of the new conveying system from reclaim hopper include a Link-Belt reciprocating feeder from bottom of reclaim hopper to belt conveyor in tunnel; with P. I. V. gear variable-speed drive to the reciprocating plate.

Thus the coal is fed uniformly to conveyor belt at the desired rate, regardless of the volume that may be dumped into reclaim hopper at a time.

By the use of Merrick Weight-



The Wing Blower is "working out to the fullest satisfaction of everyone"



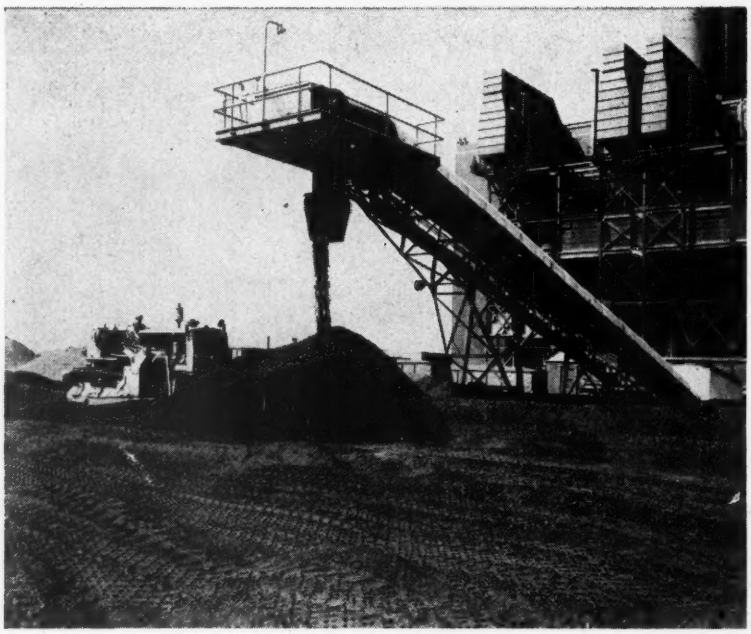
Wing EMD Blower showing simple design and built-in volume control. Internal radial dampers are actuated by an external balanced lever. Can be adjusted manually or by combustion controls.

That comment "to the fullest satisfaction of everyone," quoted from a recent letter, is characteristic of Wing Blower installations. For these Axial Flow Blowers are *built* to give satisfactory performance . . . simple and rugged construction, compact design with built-in capacity regulating dampers, combining high efficiency with quiet performance. Installation costs, too, are low. Write for descriptive bulletin or specific details.

L. J. Wing Mfg. Co. 64 Seventh Ave., New York 11, N.Y.
Factories: Newark, N.J. and Montreal, Canada

Wing

AXIAL FLOW BLOWERS



View showing coal being discharged to storage by new stocking-out conveyor at Cahokia Station, also tractor scraper for distributing and compacting coal in storage

ometer along conveyor from reclaim hopper, all coal being delivered into plant through this reclaim hopper is automatically weighed. A similar Weightometer automatically weighs and records the weight of all coal being transferred to storage yard by means of stocking-out conveyor.

Both the inclined conveyor from reclaim hopper into plant and the inclined stocking-out conveyor are equipped with band-brake type differential backstop, to prevent backward movement of conveyor belt and load in case the power is interrupted.

Two tractor-drawn scrapers are employed for spreading coal out over entire storage yard and compacting it to eliminate air spaces, thereby cutting down the risk of spontaneous combustion.

J. Wolfe is the general foreman at Cahokia. George W. Schmick is construction supervisor.

B&W PRODUCES 16 MM. SOUND-COLOR FILM ON THE DEVELOPMENT OF MODERN STEAM BOILERS

THE BABCOCK & WILCOX CO. announced the release of a new 16 millimeter educational film, "Steam for Power," which depicts the development and application of modern steam boilers. The company stated that this sound film, which is in color, will be of interest to civic groups, professional societies, engineering students and those interested in the production and use of power.

Making extensive use of both animation and photography, "Steam for Power" traces the important steps in the history of man's efforts to obtain ever more abundant and economical power by using steam to harness the energy released by the combustion of fuels.

As background to the importance of power in today's civilization, the film shows such early ideas in the use of steam for power as Hero's engine, Branca's turbine and Savery's pumps. Starting with Newcomen's and Watt's contributions, the film outlines the step by step development of boilers, such as the Haycock, Waggon, Trevithick, Cornish and firetube types.

Each step in the development of modern boilers and the reason for it is shown. The meaning of high steam pressures and temperatures is illustrated. The application and function of superheaters, economizers, air heaters, reheaters and the cyclone steam separator are explained. The development of water-cooled furnaces, pulverized coal firing, slag-tap units, dry ash removal and the cyclone furnace are depicted.

Significant steps in the manufacture of boiler components are shown. These include the bending of huge steel plates to make boiler drums, welding of drum seams, 2,000,000 volt X-raying, steel making and fabrication of seamless and welded tubing.

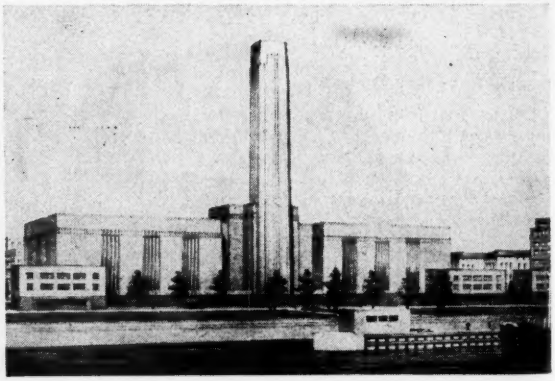
The concluding sequences of the film show the erection of a large radiant boiler in one of the country's outstanding power stations.

"Steam for Power," 16 millimeter sound-color film, has a running time of 41 minutes. It will be available on December 1, 1948, free of charge, to engineering and other professional societies, engineering schools, civic organizations and groups interested in power generation and utilization. Written requests should be made to the Advertising Division, The Babcock & Wilcox Company, 85 Liberty Street, New York 6, N. Y.

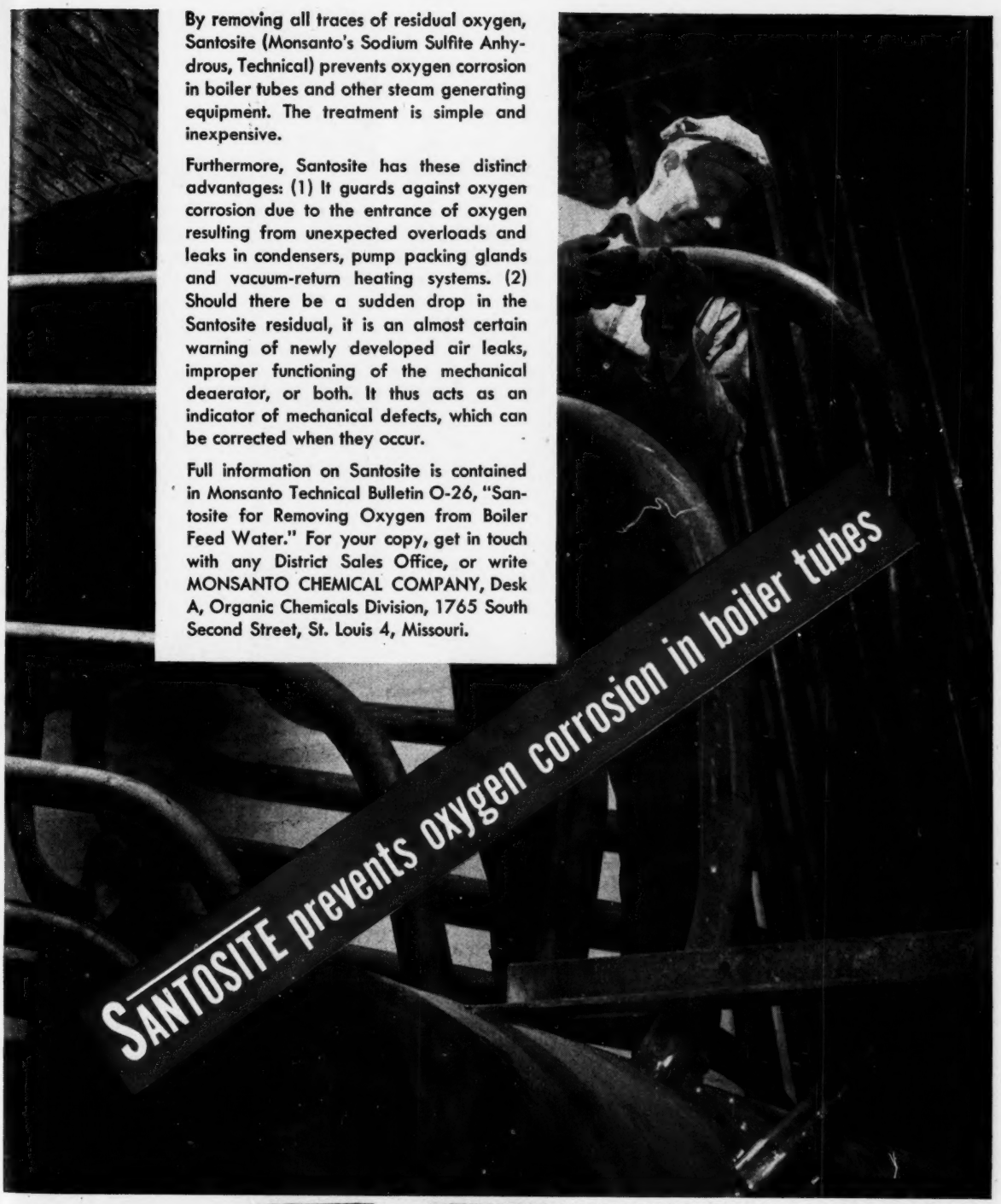
NEW BANKSIDE POWER STATION

FOR INSTALLATION IN the new Bankside Power Station in London, England, designed by Sir Giles Gilbert Scott to blend with the dignity of nearby St. Paul's Cathedral, four large steam generating units have recently been ordered from Foster Wheeler Corp. of New York. These units are each designed to produce 375,000 lb of steam per hr at 950 psi, 925 F at the superheater outlet, with 370 F feedwater inlet temperature. Condenser type superheat control will be provided for controlling the steam temperature over loads ranging from 280,000 to 375,000 lb per hr.

Steam from these units will be supplied to two 60,000-kw turbine generators. The boiler plant is unique in that it is especially designed to burn oil exclusively, in contrast to the usual coal-fired installations operating in England. Oil firing is being used to reduce atmospheric pollution to the minimum in the center of the city of London.



Architect's rendering of the new Bankside Power Station to be located on the south bank of the River Thames in the heart of London, England, where four Foster Wheeler steam generating units are to be installed



By removing all traces of residual oxygen, Santosite (Monsanto's Sodium Sulfite Anhydrous, Technical) prevents oxygen corrosion in boiler tubes and other steam generating equipment. The treatment is simple and inexpensive.

Furthermore, Santosite has these distinct advantages: (1) It guards against oxygen corrosion due to the entrance of oxygen resulting from unexpected overloads and leaks in condensers, pump packing glands and vacuum-return heating systems. (2) Should there be a sudden drop in the Santosite residual, it is an almost certain warning of newly developed air leaks, improper functioning of the mechanical deaerator, or both. It thus acts as an indicator of mechanical defects, which can be corrected when they occur.

Full information on Santosite is contained in Monsanto Technical Bulletin O-26, "Santosite for Removing Oxygen from Boiler Feed Water." For your copy, get in touch with any District Sales Office, or write MONSANTO CHEMICAL COMPANY, Desk A, Organic Chemicals Division, 1765 South Second Street, St. Louis 4, Missouri.

District Sales Offices: New York, Chicago, Philadelphia, Boston, Cleveland, Detroit, Charlotte, Birmingham, Houston, Los Angeles, San Francisco, Seattle, Portland. In Canada: Monsanto (Canada) Limited, Montreal.

Santosite: Reg. U. S. Pat. Off.

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Please send me a copy of Technical Bulletin O-26 on Santosite.

Name_____ Title_____

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City_____ State_____

SERVING INDUSTRY . . . WHICH SERVES MANKIND

INGERSOLL-RAND BOILER-FEED PUMPS *for really HIGH pressures*

Each installation of high-pressure boiler-feed pumps is a specialized job. Factors such as plant layout, load factor, feedwater treatment, boiler pressure, etc., play an important part in the design of the boiler-feed pump and the materials used in its construction.

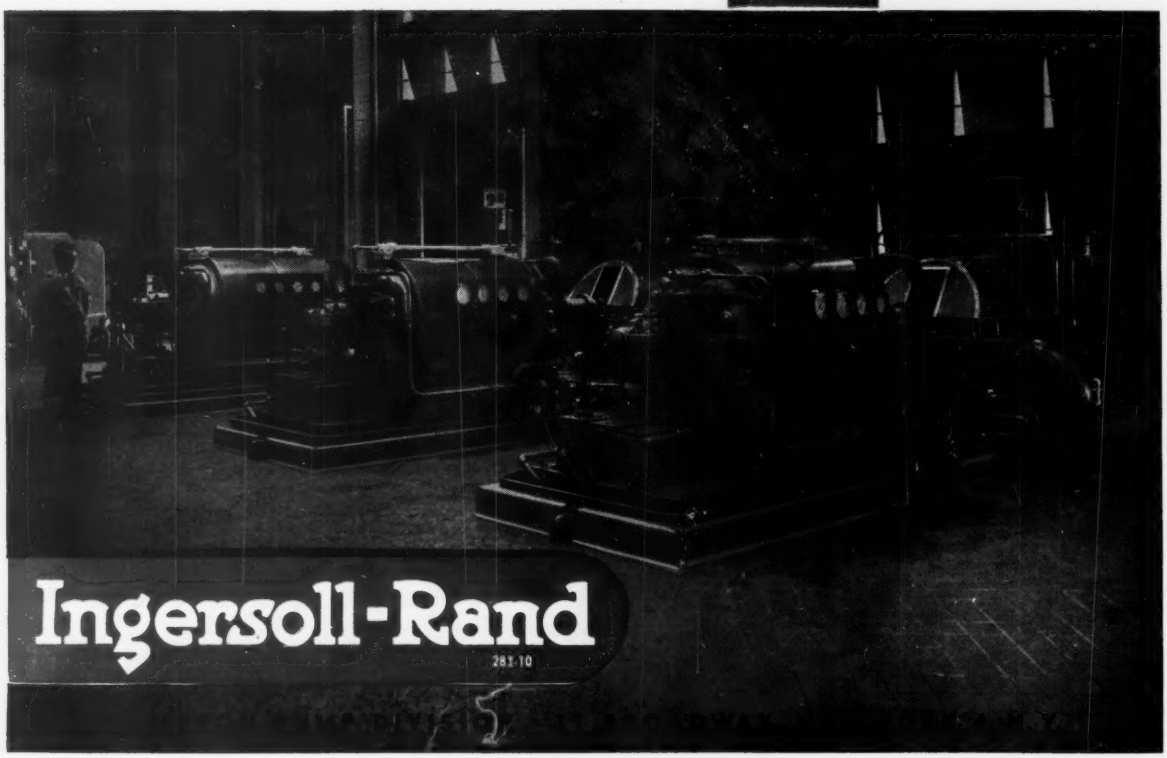
Ingersoll-Rand is eminently equipped to produce really high-pressure boiler-feed pumps for the most exacting service. I-R basic pump designs have been proven on many of the outstanding high-pressure installations. Unexcelled manufacturing, testing and metallurgical facilities insure dependable construction.

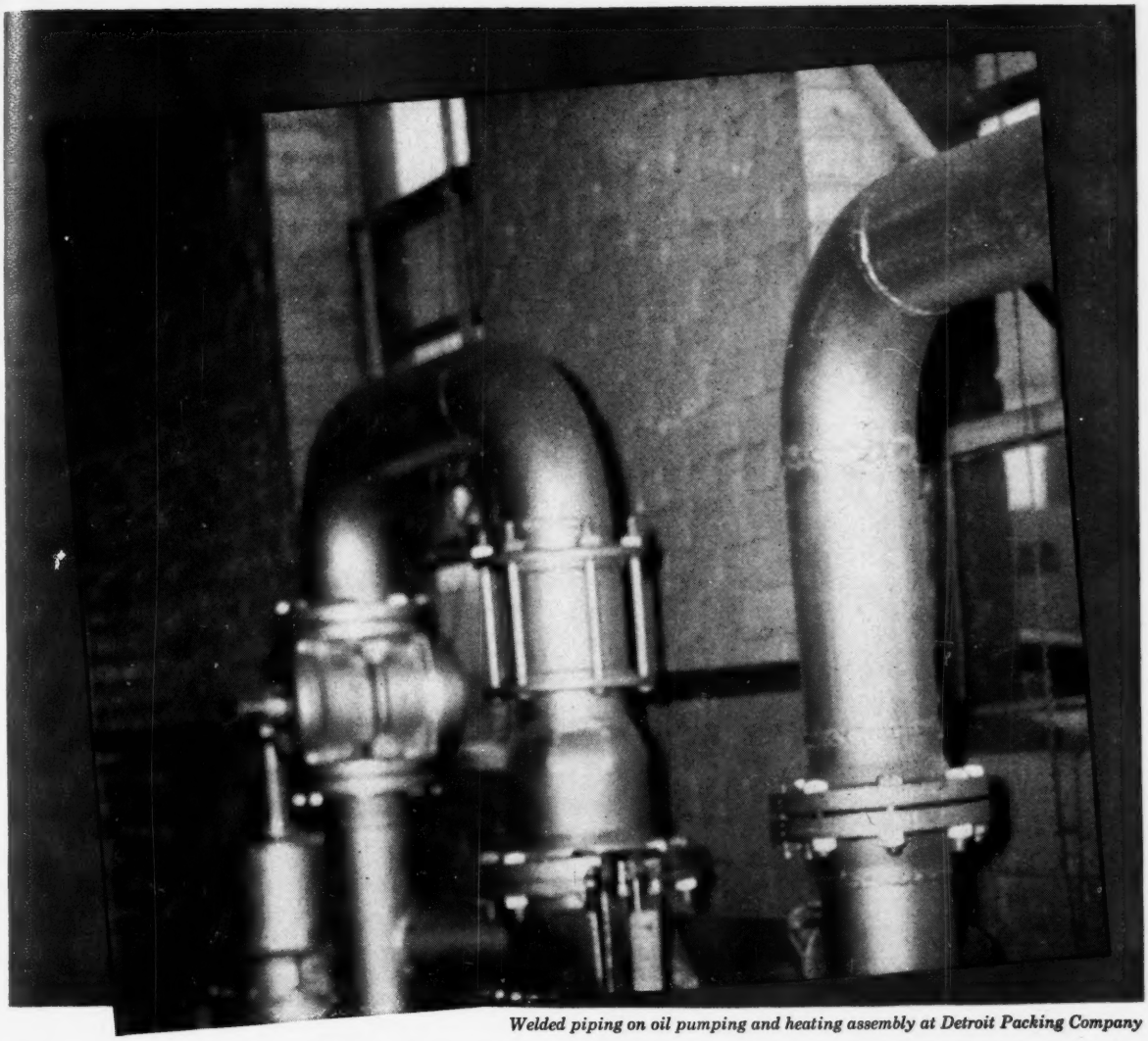
Ingersoll-Rand engineers will be glad to discuss with you the application of boiler-feed pumps to any type of plant.

Ingersoll-Rand High-Pressure Boiler-Feed Pump Installations above 1700 psi

Installation	Pump Discharge Pressure	Years in Service
A	2900	8
B	2180	7
C	1894	2
D	1890	8
E	1850	8
F	1850	8
G	1850	8
H	1830	8
I	1800	11
J	1800	7
K	1750	11
L	1750	11
M	1750	8
N	1745	2
O	1745	2
P	1720	9
Q	1720	8
R	1700	7

Many additional units in this pressure range are now in production.





Welded piping on oil pumping and heating assembly at Detroit Packing Company

"Down-time" insurance

THANKS to Tube-Turn seamless welding fittings, steam generating facilities at the Detroit Packing Company are protected against shutdowns through piping failure.

Forming a continuous metal structure with the pipe, Tube-Turn welding elbows provide leakproof joints that represent insurance against maintenance problems for many years to come.

Safe, saving, and permanent, this installation is one of the many thousands upon which the reputation of Tube-Turn welding fittings is founded. Dependable for strength, dimensional accuracy, and adherence to standards, they bear the No. 1 trade name in welding fittings.

Tube-Turn welding fittings come in a wide range of types, sizes, metals, and alloys. Your Tube Turns distributor carries a large stock. For good service in good connections, specify "Tube-Turn".

TUBE TURNS, INC.
234 E. Broadway, Dept. D, Louisville 1, Ky.

District Offices at New York, Philadelphia, Pittsburgh, Chicago, Houston, Tulsa, San Francisco, Los Angeles

TUBE-TURN

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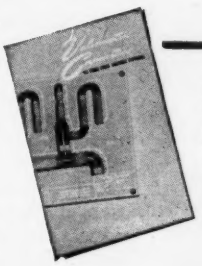
WELDING FITTINGS AND FLANGES



Write for data booklet, "Volumetric Capacities of Tube-Turn Welding Fittings."

ADSCO

heat exchangers

all shapes and sizes

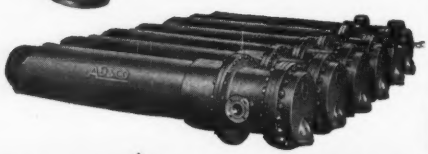
• Made of carbon steel, copper-silicon alloy, stainless steel, nickel clad and other materials.

Storage Heaters

Steam Tube Type Instantaneous Heater

Float Head Type for various services

Swimming Pool Heaters



Suction Type Heaters

AMERICAN DISTRICT STEAM CO.
NORTH TONAWANDA, N.Y.

COMMENTING recently on the Vu-Graph and the Delineascope in these columns, we suddenly thought to ourself that it was very strange if the manufacturer of the famous Balopticon did not make one of this type. Sure enough, we discovered that the model BOH Balopticon is an overhead projector with various attachments for projecting slides on a screen behind a speaker. A screen 30 by 40 in. in size is recommended and the slides are placed on a platform in front of the speaker.

Engineers reading our previous comments on overhead projectors have raised the point that they are all right for a small audience in a small room, but that apparently such overhead projectors have not been developed to project a clear image on a large screen, suitable for use in most auditoriums where engineering meetings are held. Perhaps the engineering and production genius of our combined engineering society membership could solve this one, too.

★ ★ ★

COMPETITION for some sort of prize (nobody specifies what it is) seems to have arisen in the commercial roller-coaster field. That's one publicitor's term for long outdoor belt conveyors transporting materials overland, usually on big hydroelectric construction jobs. The long belt conveyor used for hauling materials at Grand Coulee was one of the first applications of the idea.

Now comes word that the longest present-day commercial roller coaster, a 7-mile belt conveyor, the machinery for which was designed and manufactured by Hewitt-Robins, Inc., has begun the two-year job of transporting 4,000,000 tons of crushed rock used in the construction of the giant Bull Shoals Dam on White River, Ark.

The conveyor consists of 13,888 rollers, each made up of three tube-shaped steel pulleys, supporting 21 separate belts. In this fashion the rock travels from the conveyor-head at Flippin, Ark., over the Ozark hills at the rate of 525 fpm. It moves 650 tons of crushed rock every hour to the dam site.

The Bull Shoals operation is the newest illustration of how belt conveyor systems are replacing trucks and trains for increasingly longer hauls of bulk materials. Engineers cite reduced cost, less maintenance, and uniformity of flow as advantages of the system.

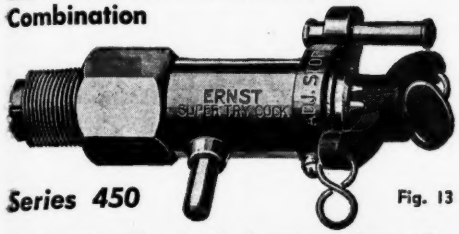
However, big as this conveyor is, a still longer one is being planned. United States Rubber Co. has announced that it has a contract to supply 12 miles of conveyor belt for the $100,000,000 Hungry Horse Dam, which will be constructed across Flathead River, near Devil's Elbow, Montana, under supervision of the Bureau of Reclamation. This belt conveyor will be designed to transport 5,000,000 tons of gravel to the dam site.

★ ★ ★

A RECENT book, The Road to Reason, by the late Lecomte de Nouy, is beginning to arouse much interest in scientific and engineering circles. The reason for the interest is that de Nouy attempts to present scientific proof of the existence of a supernatural power. There is a disposition on the part of the general public to assume that all scientists, on the basis of scientific teachings, reject God and soul. This, of course, is not true. But to use the most modern ideas in chemistry and physics as the basis for the argument makes heavy going for those unacquainted with those ideas. De Nouy criticizes the separation of technical instruction from moral education and appeals for a unification of scientific knowledge and spiritual talents.

Specify! Leakless Try Cocks

Ernst Monel Metal and Bronze Combination



Series 450 Fig. 13

This Ernst Leakless Try Cock assures maximum safety in boilers with pressures up to 450 lbs. Disc can be replaced under full boiler pressure. Sizes: ½", ¾" or 1".

pressure	cat. no.	size of conn.	type of try cock
450 lb.	E-2113	½"	Series 450 Monel-Metal and bronze combination
	E-2114	¾"	
	E-2115	1"	
650 lb.	E-2116	½"	Series 650 Chrome bronze, adjustable nozzle
	E-2117	¾"	
	E-2118	flanged	
750 lb.	E-2119	½"	Series 750 Forged steel, square body
	E-2120	¾"	
	E-2121	flanged	
1500 lb.	E-2122	½"	Series 1500 Forged steel, square body
	E-2123	¾"	
	E-2124	flanged	
2500 lb.	E-2125	⅜" or ½"	Series 2500 Forged steel, stainless steel seat
	E-2126	flanged	

Fig. 15

250 lb. pressure bronze, with iron weight double chain pull.

WATER GAGES & GAGE VALVES

FOR ALL PRESSURES AND TEMPERATURES

BRONZE, FORGED STEEL, ALL IRON, STAINLESS STEEL

Gages can be furnished with Automatic Ball Shut-off if required.

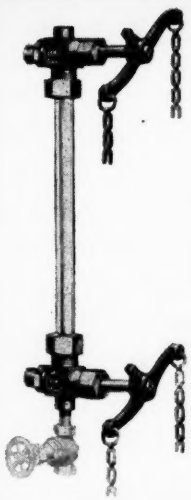


Fig. 5

Standard Vertical bronze water gage 350 pound design, heavier construction up to 450 lbs., Stainless and forged steel for higher pressures.

Fig. 8

All Iron gages for pressure up to 250 lbs., heavier construction up to 350 lbs.

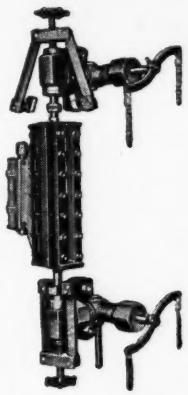


Fig. 72

For steam pressure above 500 pounds we recommend ERNST Flat Gage Glass Inserts with "Split-Gland" Gages. (Write for Bulletin Q.)

Ernst SPLIT-GLAND Adjustable water gages, bronze and forged steel construction, can be furnished with screwed or flanged connections. GAGES may be set INCLINED or VERTICAL, made to fit any type of Water Column or boiler.

Fig. 1-GF

HIGH PRESSURE GAGE GLASSES

AND SERIES 750 COMPOSITION GAGE GLASS GASKETS

MANUFACTURED IN ALL SIZES TO FIT YOUR WATER GAGES

FLAT TYPE REFLEX AND CLEAR

CLEAR AND RED-LINE MAGNIFYING TYPE

Fig. 22 STANDARD

Fig. 21 LIP MOLD

OTHER ERNST SPECIALTIES

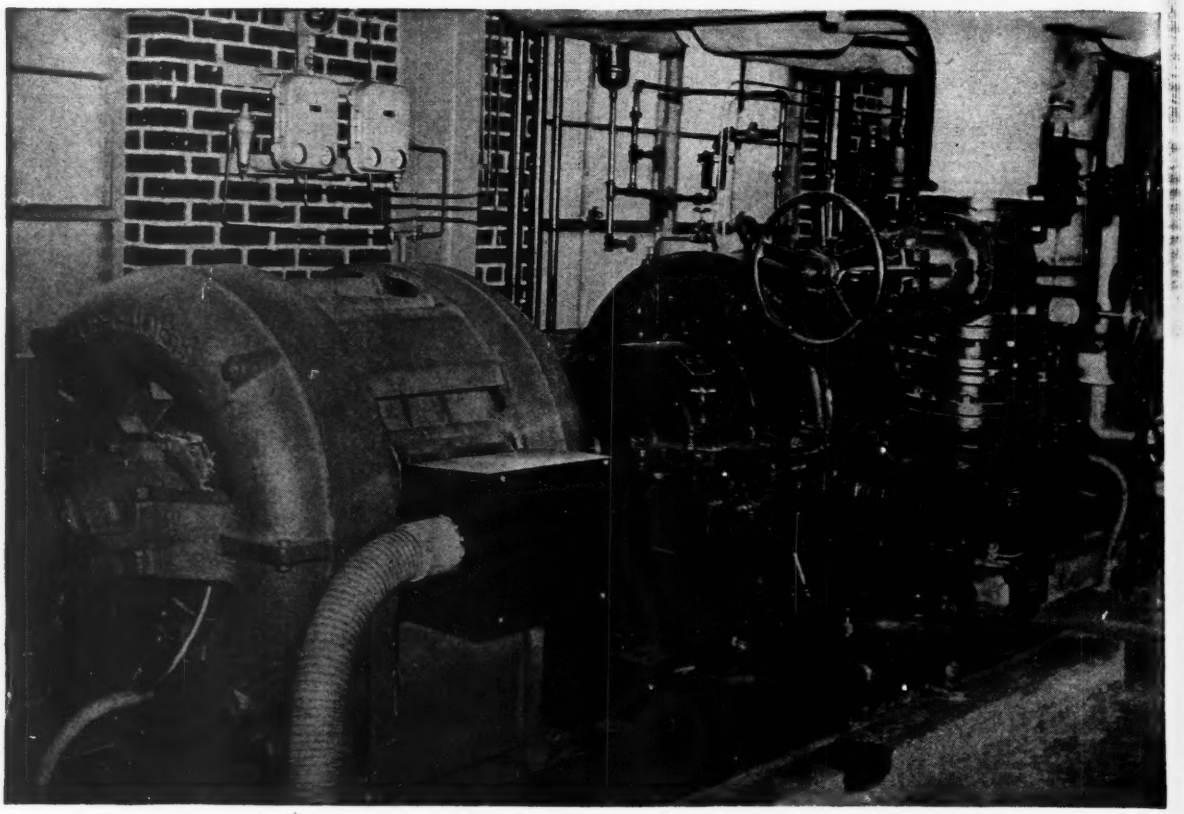
- High and Low Alarm Columns
- Split-Gland Water Gages
- Gage Glasses Illuminators
- Flat Glass Inserts
- Sight Glass and Discs
- Safety Plastic Guards
- Sight Flow Indicators
- Refinery and Chemical Liquid Level Gages and Valves for All Kinds of Service, Etc.

STATE YOUR REQUIREMENTS—*Send for Catalog*

ERNST WATER COLUMN & GAGE CO.

Off... and Works: 250 South Livingston Avenue, Livingston, New Jersey ... Phone: Livingston 6-1400

The TERRY TURBINE



For By-Product Power and Steam Balance

This 200 kw Terry Turbine driven generating unit operates in parallel with other generating equipment, the load on the unit being adjusted in accordance with the demands for exhaust steam. It is a single stage axial-flow, type, 4500/1200 rpm, 160 psi, 0 superheat, 5 psi back pressure, equipped with Terry reduction gears, oil-relay governor, motor synchronizer and back-pressure regulator.

The installation pictured above is typical of many special applications of Terry Steam Turbines, each designed for specific requirements.

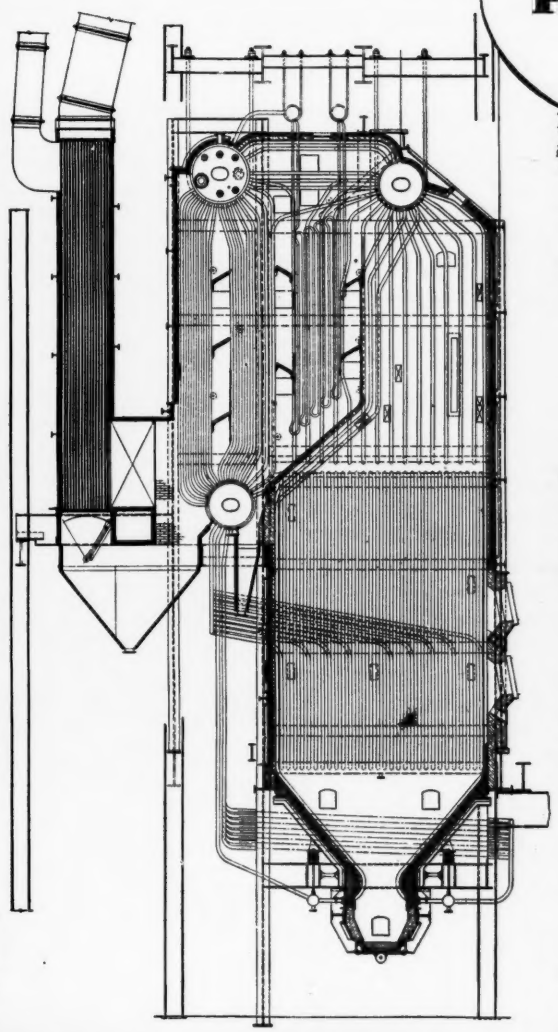
Any of our district representatives will gladly give you full information on a turbine to meet your requirements, no matter how special they may be.

No obligation, of course.

T-1176

THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD, CONN.

300,000
POUNDS OF STEAM PER HOUR



Purchaser—
Minnesota Power & Light Company

Location—
Duluth Steam Electric Station
Duluth, Minn.

Number of Boilers 1

Pounds of Steam/Hr. 300,000

Design Pressure . . . 550 PSI

Operating Pressure . 450 PSI

Final Steam Temperature . . . 830° F.

Air Preheater—
Erie City Tubular

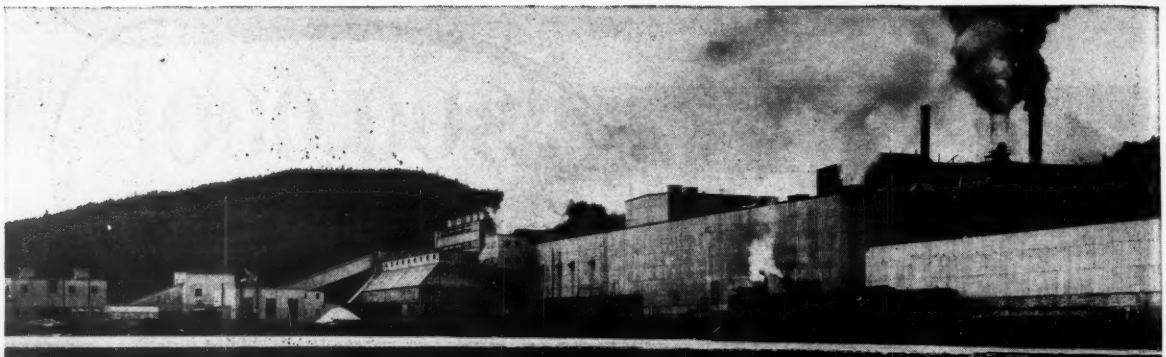
Water Walls—
Erie City Bare Tube

STEAM POWER PLANT EQUIPMENT

Complete Steam Generators • Type C 3-Drum Boilers • Type VL 2-Drum Boilers • The "Economic" Boiler with or without Water Walls • Welded H. R. T. Boilers • Welded Steel Heating Boilers • Coal Pulverizers • Underfeed Stokers and Welded Pressure Vessels for the Process Industries.

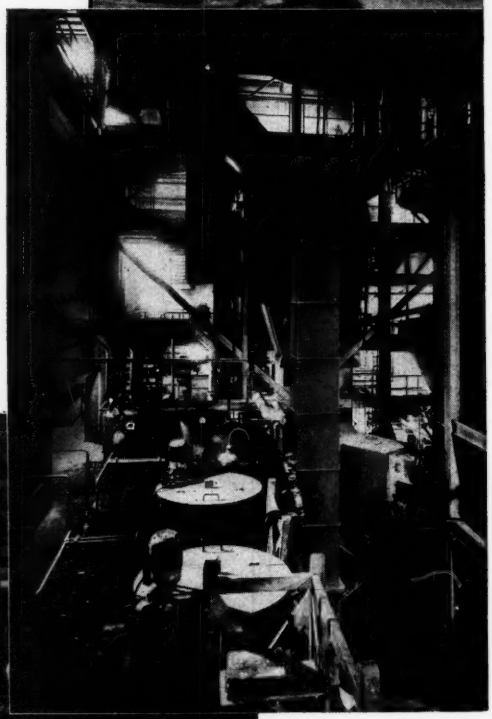
ERIE CITY
SINCE 1840

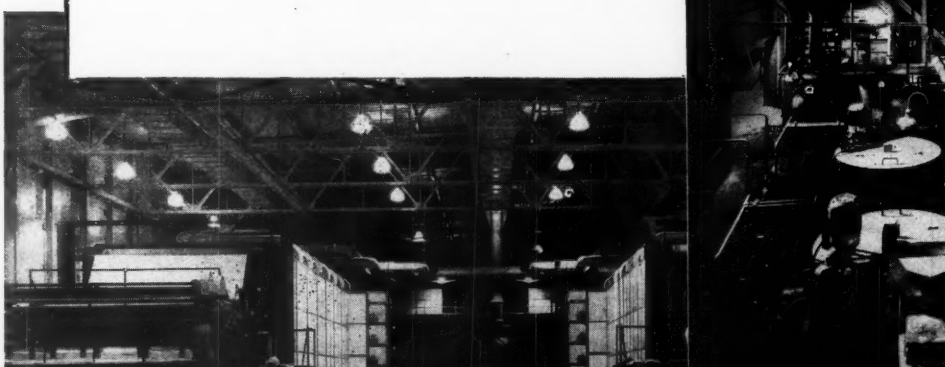
ERIE CITY IRON WORKS • ERIE,



. . . AS A SUPPLEMENTARY ORGANIZATION

To expedite the design and construction of a Pulp Mill for Marathon Paper Mills of Canada, Ltd., Stone & Webster Engineering Corporation established a supplementary organization of engineers, specialists and draftsmen to act as part of the client's own engineering department. The Engineering Corporation also furnished consulting advice on special phases of the project and supervised all the construction.





The Bleached Sulphate Pulp Mill of Marathon Paper Mills of Canada, Ltd., located at Marathon, Ontario, on the North Shore of Lake Superior.

Above: Power and Recovery Boiler Room. Left: Machine Room — Dry End.

STONE & WEBSTER ENGINEERING CORPORATION

A SUBSIDIARY OF STONE & WEBSTER, INC.

Hey, Pop ... would Water Treatment help?

Pop's on the spot. There are no parts left over and still the pygmy power plant won't produce a single putt or puff. It won't even give a hoot. Believe it or not, water "treatment" will help . . . a cupful or two of any kind of water in that empty boiler.

But it takes more than "any kind of water" to produce good results in a full-size operation. Whether used for power, process or cooling, water frequently needs correction. Otherwise scale, corrosion and carryover will send efficiency down, operating costs up. Water and steam-handling equipment will have a short and unhappy life.

Your best insurance against such costly headaches is a complete, time-proved water treatment system, such as that developed out of Bird-Archer's 60-plus years of field experience in solving water treatment problems.

An informative illustrated booklet discusses these problems and their solutions. Write for your copy today.

BA-131

New Booklet

You'll find water treatment problems discussed in detail in this Bird-Archer Booklet. The Bird-Archer 8-point Service — all or any part of which is available to you — is fully described. For a clear picture of what an elastic and complete treatment program can accomplish in *your* plant, be sure to send for this booklet on your business letterhead.

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CALDERAS Y ACCESORIOS, S. A. AMSTERDAM 291, MEXICO, D. F.

FREE

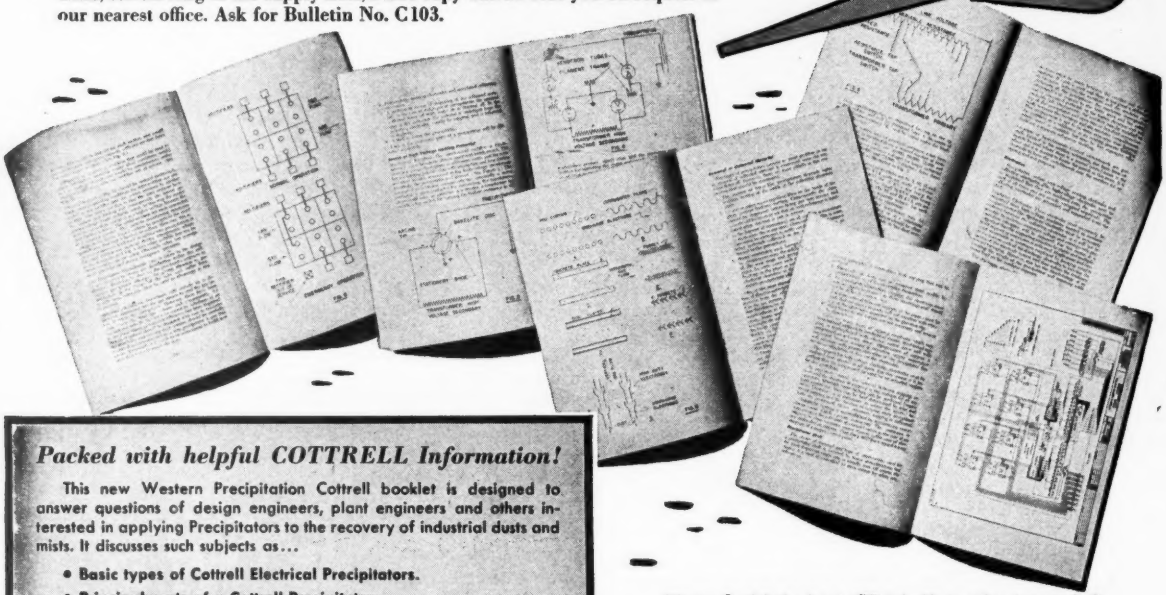
From Western Precipitation—the organization that pioneered the commercial application of Cottrell Precipitation...

IF YOU ARE ENGAGED in any phase of industry where the recovery of dusts, fumes, fly ash, mists, fogs or other suspensions from gases is a problem, you will find this new booklet on the COTTRELL Electrical Precipitator helpful and informative.

Western Precipitation pioneered and installed the first commercial application of the well-known COTTRELL Electric Precipitator—Dr. Cottrell, the inventor, being a member of the company. And for more than 38 years Western Precipitation has consistently led in developing new COTTRELL advancements and techniques for recovering suspensions from gases, both wet and dry.

This new 28 page booklet summarizes many of the basic facts you should know about modern COTTRELL Precipitators—the various types available, how they operate, principal types of electrode systems and rectifiers, shell constructions, etc. As long as the supply lasts, a free copy will be sent you on request to our nearest office. Ask for Bulletin No. C103.

28 PAGES
of helpful facts to know about
COTTRELL ELECTRICAL PRECIPITATORS



Packed with helpful COTTRELL Information!

This new Western Precipitation Cottrell booklet is designed to answer questions of design engineers, plant engineers and others interested in applying Precipitators to the recovery of industrial dusts and mists. It discusses such subjects as...

- **Basic types of Cottrell Electrical Precipitators.**
- **Principal parts of a Cottrell Precipitator.**
- **Mechanical and Electronic Rectifiers.**
- **Various types of Collecting Electrodes (rod curtains, corrugated plates, dual plates, pocket electrodes, etc.).**
- **Removal of Collected Material.**
- **Factors in Shell Construction (steel, concrete, brick, etc.).**
- **Operating Efficiencies and the Effect of Various Factors on Performance.**

...and many other basic Cottrell facts. Write for your free copy of Bulletin C103 today while supplies are adequate!

Western Precipitation is not affiliated with any other company in the field of electrical precipitation except its wholly owned subsidiaries, International Precipitation Corporation and the Precipitation Company of Canada, Ltd. Whether you are now contemplating the installation of a Cottrell Electrical Precipitator, or may be interested in such an installation at a future date, we can and will serve you in any part of the United States or other countries.

NOW SELLING...

COTTRELL Precipitators
MULTICLONE Collectors
TURBULAIRE Spray Dryers

...in all parts of the U. S. A. and foreign countries.

WESTERN Precipitation CORPORATION

ENGINEERS, DESIGNERS & MANUFACTURERS OF EQUIPMENT FOR COLLECTION OF SUSPENDED MATERIALS FROM GASES & LIQUIDS

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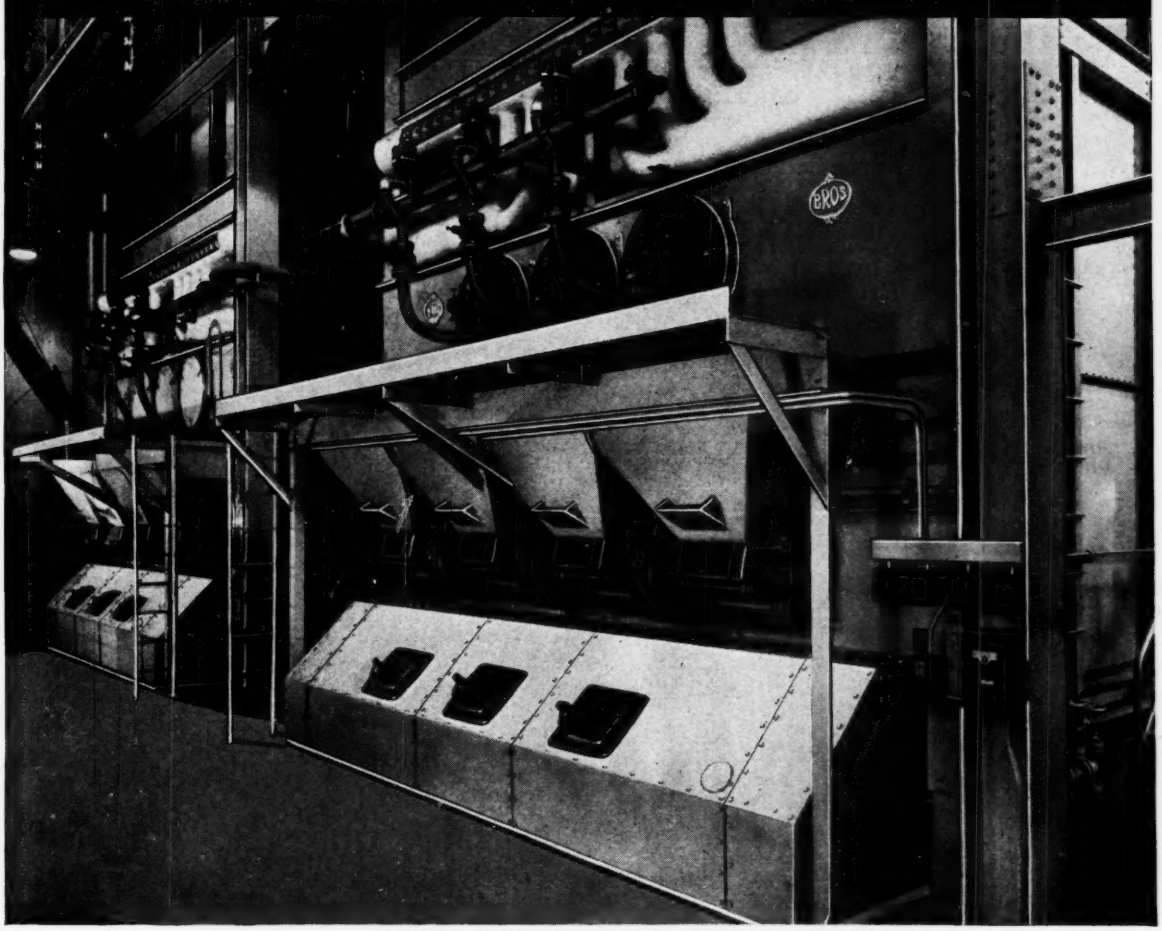
PRECIPITATION CO. OF CANADA, LTD., DOMINION SQ. BLDG., MONTREAL

One furnace...three fuels



SWITCH TO COAL, OIL OR GAS IN A MATTER OF MINUTES

● *Bros* engineers have achieved this remarkable new fuel flexibility by designing a steam generating unit fired by *Bros Travl-Spred* continuous ash discharge spreader stokers and combination gas and oil burners.

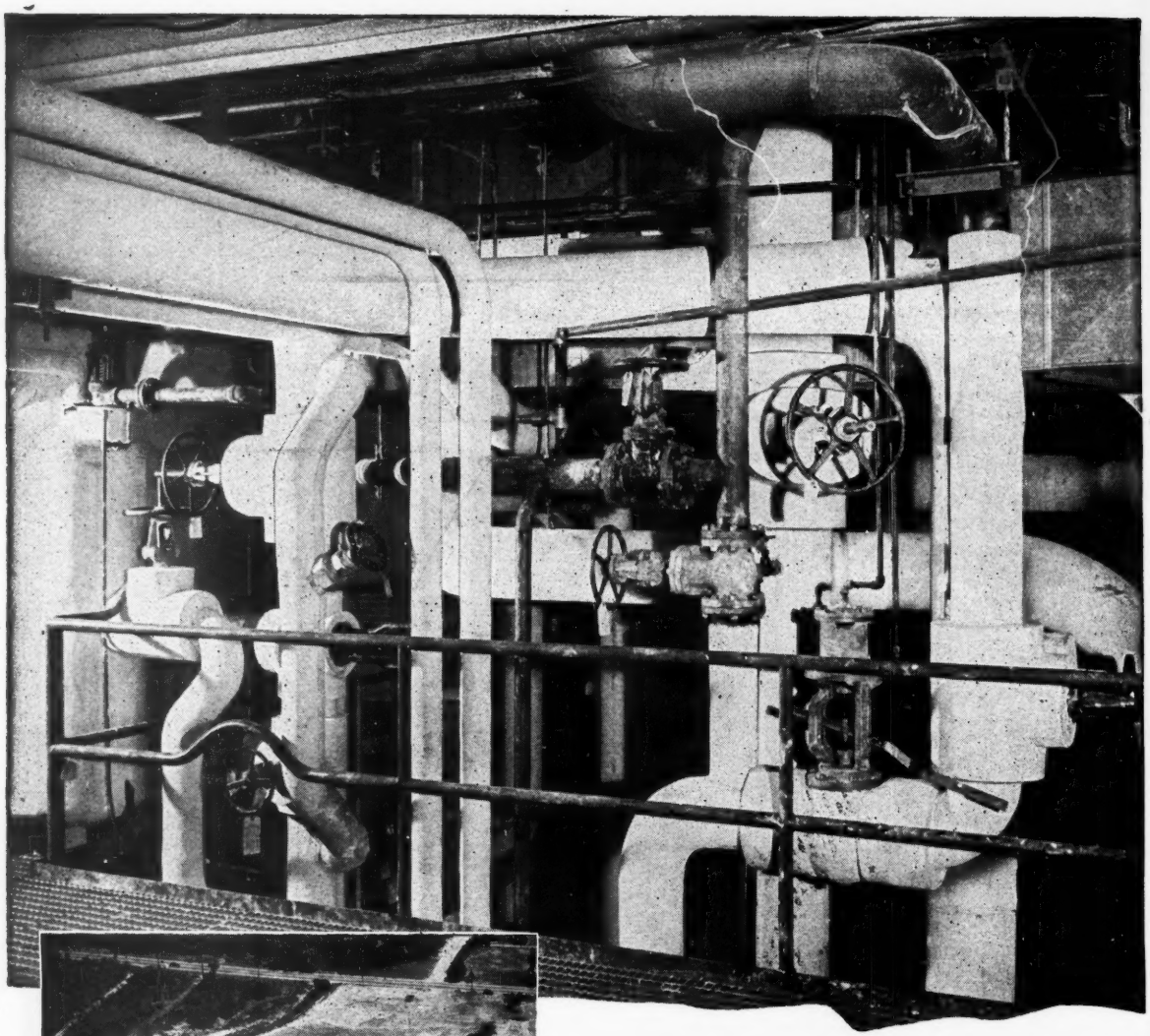
This is *Bros'* answer to today's critical problem of fuel availability. And it can free you, as a manufacturer, from the imminent threat of short supply—whether it be coal, oil or gas. For with this *one* furnace, you can use *three* fuels—and switch from one to the other easily, simply, in a matter of minutes!

In the installation pictured (B. F. Nelson Mfg. Co., Minneapolis), these two *Bros* 90,000 lb. combination units supply continuous power and process steam for the manufacture of roofing paper.

But whatever you manufacture, you can eliminate costly shut-downs due to fuel availability problems just as the B. F. Nelson Mfg. Co. has. The first step is a letter to Wm. Bros Boiler and Mfg. Co., Minneapolis, Minnesota, for complete specifications and details on this new *Bros* Combination Unit.

BROS

WATER TUBE, FIRE TUBE BOILERS • OVER FEED, UNDER FEED • HYDRAULIC-TRAVL-SPRED STOKERS



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Navco's high degree of engineering skill and use of the most modern plant and field facilities are your guarantee of a long lasting and trouble-free piping system.

Consult Navco for Your Next Piping Job

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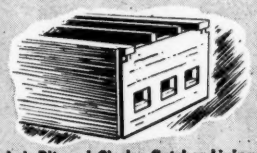
STOP CORROSION... IMPROVE DRAFT

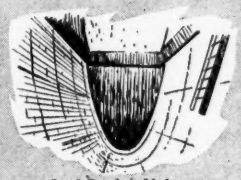
with LUMNITE STACK LININGS

WHERE TO USE LUMNITE IN POWER PLANTS

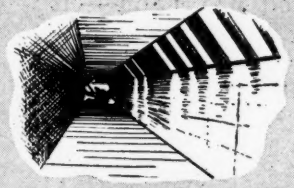
Steel Stack Linings



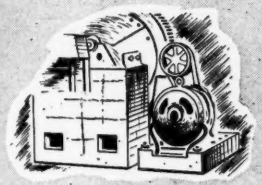
Ash Pit and Cinder Catcher Linings



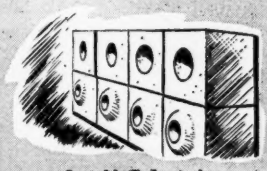
Coal Bunker Linings



Flue and Duct Linings

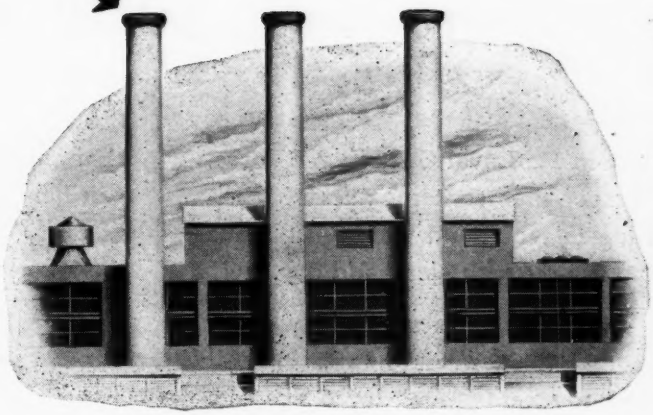


Overnight Structural Concrete



Castable Refractories

Factory-prepared mixtures of LUMNITE and selected aggregates. Mixed with water on the job; cast into place for door linings, arches, baffles, furnace walls. Special shapes can be cast in molds, ready within 24 hours. Castables to meat different temperature and insulation needs are made by refractory manufacturers, sold by their distributors.



Your steel stacks get full protection from corrosion and heat when LUMNITE linings are installed. These linings boost drafts by keeping gas temperatures up. They resist attacks of condensate and sulphurous gases. Linings are jointless, allow no "breathing." LUMNITE thus adds years of service to old stacks. In new stacks, LUMNITE heat- and corrosion-resistant concrete protects the steel indefinitely.

LUMNITE linings are easily installed. Reinforcing mesh is attached to steel angles or other projections welded to the steel shell . . . the mixture of LUMNITE and insulating corrosion-resistant aggregate is applied over the reinforcing mesh. Ready 24 hours after installation, LUMNITE linings reduce outage time to a bare minimum.

In stacks, as well as other power plant installations, listed in the column at left, LUMNITE provides high structural strength, high heat resistance and low thermal conductivity.

PG-L-2

Lumnite Division

UNIVERSAL ATLAS CEMENT COMPANY

UNITED STATES STEEL CORPORATION SUBSIDIARY

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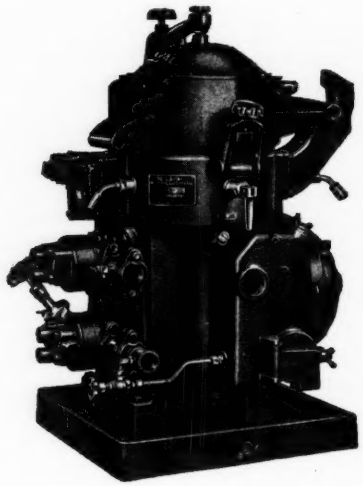
TWO-WAY PROTECTION FOR YOUR POWER PLANT

"I am De Laval Centrifugal Force. I remove ***both*** contaminants of lubricating oil—dirt and water—and thus keep the oil both clean and dry.

"Engineers never worry about contamination in their lubricating oil when my centrifugal force protects their power units. Whether it is a turbine where condensate is as apt to be the problem as dirt is, or a Diesel engine where carbon and other solids are most important, a De Laval "Uni-Matic" Oil Purifier will provide unfailing protection.

"Fuel oil, too, gives better heat value when impurities are first centrifuged out. Diesel engineers know that centrifugal force can be more than lubricating oil protection — it can help get the full BTU value out of every drop of oil."



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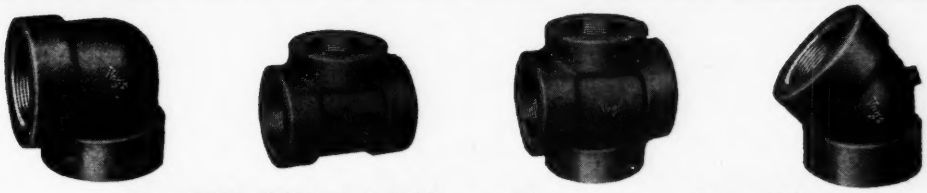
DE LAVAL *OIL PURIFIERS*

FOR MORE DEPENDABLE POWER PRODUCTION

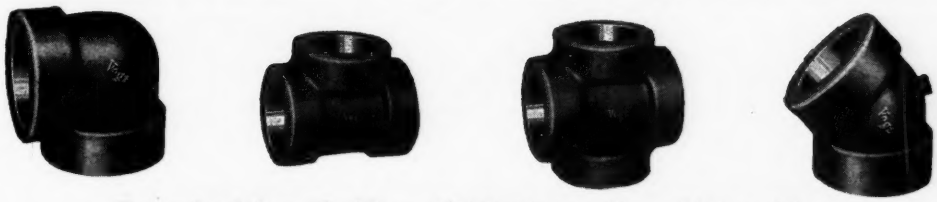
STRENGTH

for Safety and Long-Time Service



For 2000, 3000 and 6000 pounds service — Sizes 1/8" to 6"

SCREW END TYPE

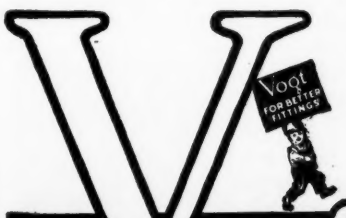


For schedules 40, 80 and 160 pipe — Sizes 1/8" to 4"

SOCKET WELD TYPE

Vogt Ells, Tees, Crosses, etc., are forged from carbon steel or various alloys to meet specific operating conditions. Catalog F-8 will aid you in their selection and proper application.

Shocks and stresses imposed by high pressures and high temperatures are taken in their stride because Vogt fittings are uniform in structure, fine grained, and free from porosity . . . the superior product of laboratory controlled materials and giant forging hammers and upsetters. These properties also give higher resistance to erosive and corrosive conditions, thereby adding to service life expectancy in steam plants, petroleum refineries, chemical plants and related industries.



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Vogt DROP FORGED STEEL FITTINGS

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you get a Union that's

DROP-TIGHT
ECONOMICAL
STURDILY BUILT
EASILY INSTALLED

Their two bronze seats, ground to a true ball joint, mean longer service

Dart Unions are different. Their tightness is not derived from an ordinary "jammed" joint, but from two bronze seats ground to a *true ball joint*. They close drop-tight without excessive wrench pressure and open just as easily. What's more, they can be used over and over again in different locations. Both the body and nut are made of high-test, air refined malleable iron and are practically indestructible.

Let your supplier show you Dart's unique construction.

E. M. DART MFG. CO.
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DART UNIONS

COMING EVENTS

ASHVE—The Ninth International Heating and Ventilating Exposition will be held in the International Ampitheater, Chicago, January 24-28.

ASTM—The Spring Meeting and ASTM Committee Week, to be held at the Edgewater Beach Hotel, Chicago, February 28 to March 4.

WMCE—The Sixth Western Metal Congress and Western Metal Exposition will be held at the Shrine Auditorium, Los Angeles, April 11-15.

NDHA—The 40th Annual Meeting of the National District Heating Assn. will be held at The New Ocean House, Swampscott, Mass., May 24-27.

ASTM—The 52nd Annual Meeting of the American Society of Testing Materials to be held at the Chalfonte-Haddon Hall, Atlantic City, June 27 to July 1.

ASTM—The First National meeting of the American Society of Testing Materials to be held on the West Coast will be held at the Fairmont Hotel, San Francisco, October 10-14.

Obituaries

RICHARD J. BLUM, SR.

R. J. BLUM, SR., co-founder and president of the Kirk & Blum Manufacturing Co., died at his home in Cincinnati on Monday, October 18, 1948.

Mr. Blum was born October 9, 1886 in Cincinnati. Nineteen years later he met the late Sylvester W. Kirk, with whom he organized the company. The two first met when Mr. Blum answered an advertisement in 1905 for a worker at the old Cincinnati Exhaust and Blowpipe Co. There he met Mr. Kirk, who two years later in 1907, approached Mr. Blum with the idea of forming a company.

Mr. Blum became president of the firm three years ago, succeeding to that position upon the death of Mr. Kirk.

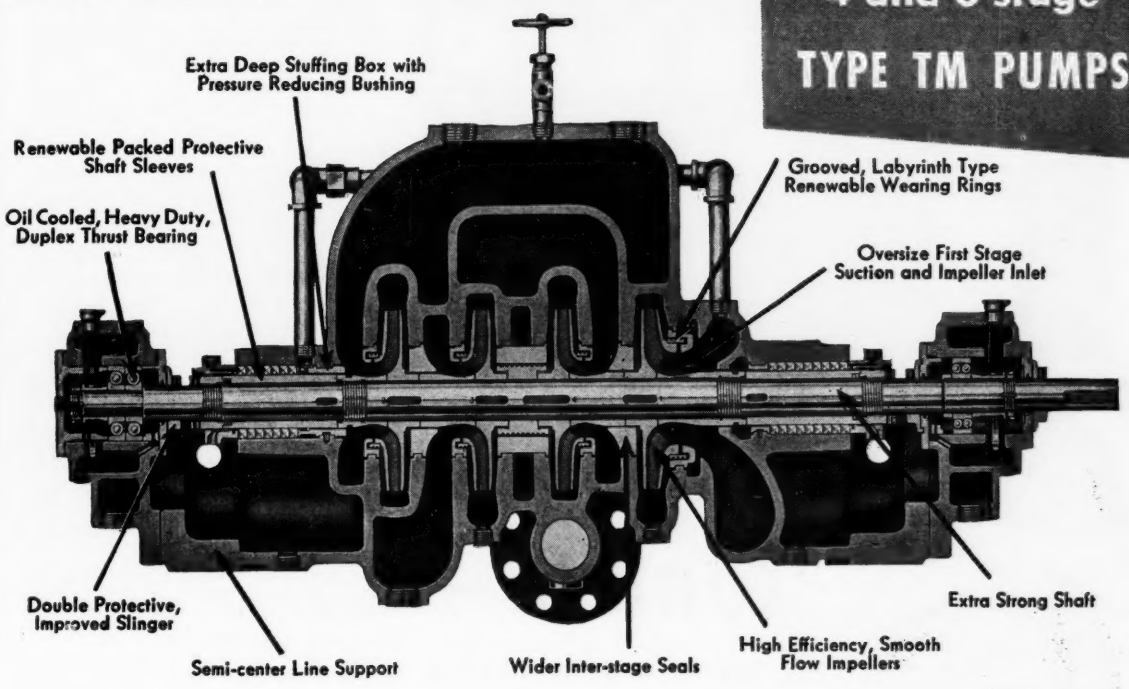
WILLIAM D. HALSEY

WILLIAM D. HALSEY, chief engineer of the boiler division of The Hartford Steam Boiler Inspection and Insurance Co., died suddenly at his home in West Hartford, Conn., December 9.

Mr. Halsey was born in Philadelphia, Pa., on February 28, 1890. He received a degree in Mechanical Engineering from Swarthmore College in 1912. Before his association with the company in 1920, Mr. Halsey was a design and maintenance engineer for the Sharples Separator Co. and the Baldwin Locomotive Works, and he served as professor of mechanical engineering at George Washington University for five years. During World War I, he was

Here's why you get longer life, higher efficiency, greater dependability from

WARREN
4 and 6 stage
TYPE TM PUMPS


Extra Deep Stuffing Box with Pressure Reducing Bushing
Renewable Packed Protective Shaft Sleeves
Oil Cooled, Heavy Duty, Duplex Thrust Bearing
Grooved, Labyrinth Type Renewable Wearing Rings
Oversize First Stage Suction and Impeller Inlet
Extra Strong Shaft
Double Protective, Improved Slinger
Semi-center Line Support
Wider Inter-stage Seals
High Efficiency, Smooth Flow Impellers

Radial and Axial Balance

Increased dependability, efficiency and life result from Warren TM pumps being in radial balance as well as axial balance. Radial balance is achieved by having half the number of stages discharging up and the other half down, thus eliminating dangerous shaft deflections which cause excessive wear at all close fits, reducing efficiency. Axial thrust is controlled by mounting impellers back-to-back, thus avoiding troublesome balancing drum or thrust plate.

Lower Maintenance

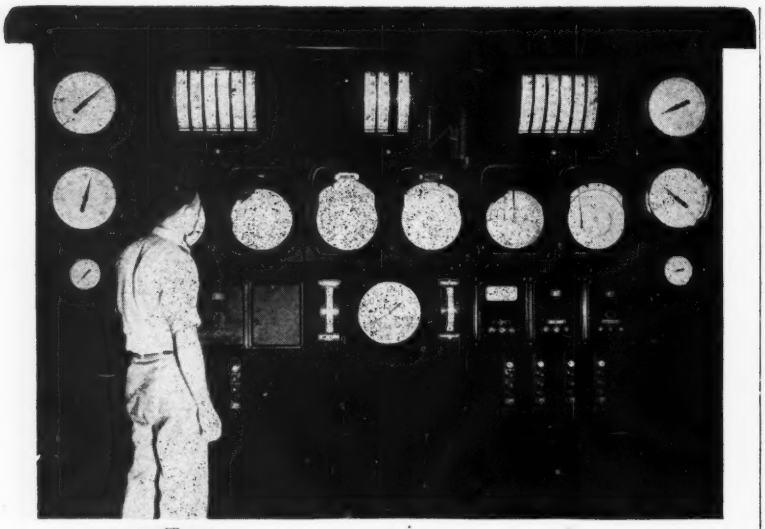
Every possible care has been taken in design and construction of Warren Type TM Pump to insure utmost dependability and highest efficiency through elimination of danger of failure and reduction of wear to absolute minimum. Thus low maintenance is assured. Wherever wear is inevitable after long service, renewable parts are provided and all parts are easily accessible. Horizontally split case allows complete access to rotor, or its removal, without disturbing main connections.

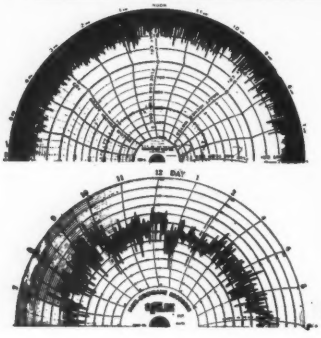
Send for bulletin #241 . . . . . or better, send an outline of your pumping problem and get a Warren recommendation.

Mohawk Carpet Mills, Inc., Amsterdam, N. Y., is one of the outstanding industrial concerns where Warren Pumps are on the job. Here you see a Warren TM 4 stage pump on boiler feed service, 500 # p. s. i. delivering 500 g. p. m. Mohawk has since purchased a second Warren TM Pump.

Warren Steam Pump Company, Inc.
WARREN, MASSACHUSETTS P-15

WARREN PUMPS





optional control—

AT THE FLIP OF A SWITCH

• Brown-Forman Distillers Corporation of Louisville wanted automatic combustion control on their three power plant boilers; but faced a problem in that one boiler is fired with coal mixed with wood waste from the cooperage plant, when available—otherwise with coal alone. The wood waste, varying from saw dust to coarse hog fuel, is not adapted to automatic control—therefore the control system must provide for easy change-over from automatic to manual operation.

• Hays operation solved this problem instantly: full automatic operation when burning coal alone—manual operation for burning wood and coal; and only a flip of a switch to change from either method to the other—no complicated linkages to disconnect, no time lost. An average of 70 percent efficiency is maintained, CO_2 averages 12 to 14 percent and the stack is clear.

• If you are seeking to improve steam plant efficiency and reduce fuel costs, look well at this truly modern system. Talk over your combustion needs with Hays engineers—good men to consult. No obligation, of course. In the meantime write for Publication 47-605—you'll find it exceedingly helpful.

THE HAYS CORPORATION • MICHIGAN CITY, INDIANA

HAYS *Automatic* COMBUSTION CONTROL

INDUSTRIAL INSTRUMENTS INDUSTRIAL CONTROL FLOWMETERS GAS ANALYZERS DRAFT GAGES CO₂ RECORDERS

a technical adviser for the National Advisory Committee for Aeronautics.

Mr. Halsey joined the company on June 15, 1920, as editor of its technical magazine, The Locomotive. In 1925 he was transferred to the engineering department with the title of mechanical engineer and was made assistant chief engineer of the boiler division on May 1, 1930. His promotion to chief engineer came in January, 1943.

He was active in many engineering organizations, among which were the American Welding Society and the American Society of Mechanical Engineers. He had served the latter organization as a member of the Boiler Code Committee since December, 1944.

ALBERT A. POPE

ALBERT A. POPE, 81 years old, former assistant general commercial manager of the New York Edison Company, which is now the Consolidated Edison Company of New York, died recently at his home.

A pioneer in the electric utility business, Mr. Pope began his career in 1889 with the Edison Electric Illuminating Co. of Brooklyn. He transferred to the New York Edison Co. the following year and was one of four men who organized what is now the sales department of Consolidated Edison. He retired in 1929, but continued as an officer of the Edison Savings and Loan Association, an employees' group, until 1942.

He was a charter member of the Edison Association and had been a director, vice-president and chairman of the appraisal committee since its organization in 1912. He was president in 1928. He was also a member of the Illuminating Engineering Society, National Electric Light Association, Edison Pioneers and Salmagundi Club. During the Spanish-American War he was one of a group of experts who worked with the Navy in mining New York harbor.

ASME MEETING

(Continued from page 75)

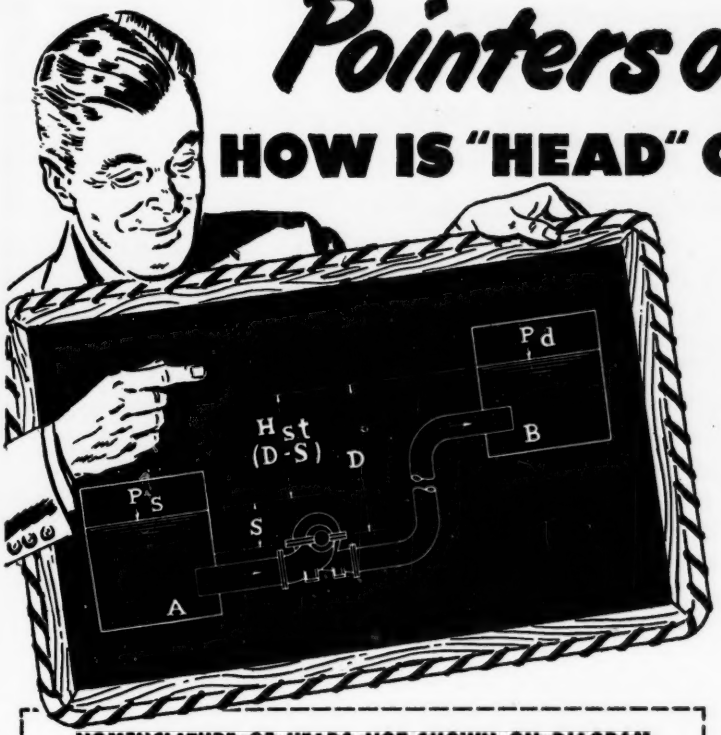
yond any now within our realm of knowledge, or even speculation.

Synthetic Fuels

Immediate development of synthetic fuel plants is essential to the economic welfare and military security of the United States, the meeting was told by W. S. Schroeder, chief of the Office of Synthetic Liquid Fuels, Bureau of Mines. To meet the anticipated civilian requirements, an additional 1½ to 2 million barrels a day will have to be obtained. Synthetic oil from coal and oil shale offers an assured supply for hundreds of years within the borders of the United States—self sufficiency in peace or war—but

Pointers on Pumps

HOW IS "HEAD" CALCULATED?



The total head of a centrifugal pump is the energy it imparts to the liquid, and is determined by finding the difference between discharge head and suction head. Thus, as a suction lift is a negative suction head, the total head is the sum of the discharge head and the suction lift.

If the discharge head and the suction head are not determined independently, the total head can be calculated by determining the algebraic sum of (1) the static head from supply level to discharge level, (2) all friction losses for the capacity considered, (3) entrance and exit losses and, (4) terminal pressure minus suction supply pressure. For complex systems involving both vacuums and pressures it is often easier to convert these factors into absolute pressure values, expressed in feet of the liquid handled.

When measured by gages at the pump's suction and discharge opening, the total head is the discharge head minus the suction head. Discharge head is the sum of the discharge gage reading, corrected to the pump center line, and the velocity head at the point of the gage's attachment. Suction head is found by applying the same formula to the suction gage reading. Since it is easy to get the plus and minus signs of the various elements reversed, and because of the many precautions necessary in taking gage readings, it is advisable to follow the instructions in the Test Code of the Hydraulic Institute.

The diagram shows the heads involved in calculating suction head, discharge head, total head and NPSH. (The term "NPSH" was discussed in a previous advertisement in this series. Reprints are available on request.)

NOMENCLATURE OF HEADS NOT SHOWN ON DIAGRAM

h_{fs} = friction head loss in suction line

h_{fd} = friction head loss in discharge line

h_f = total friction head loss from A to B

*h_i entrance loss at A

*h_e = exit loss at B

P_{vp} = vapor pressure of liquid at pumping temperature

All heads and pressures must be expressed in feet of liquid with proper algebraic signs. Pressures P_s, P_d and P_{vp} can be either in gage or absolute values but, in any case, must all be measured above the same datum.

*Some engineers include these losses in h_{fs} and h_{fd}.

$$\text{SUCTION HEAD} \quad h_s = S - h_{fs} - h_i + P_s$$

$$\text{DISCHARGE HEAD} \quad h_d = D + h_{fd} + h_e + P_d$$

$$\text{TOTAL HEAD} \quad H = h_d - h_s$$

$$= H_{st} + h_f + h_i + h_e + (P_d - P_s)$$

$$\text{NPSH} = S - h_{fs} - h_i + P_s - P_{vp}$$

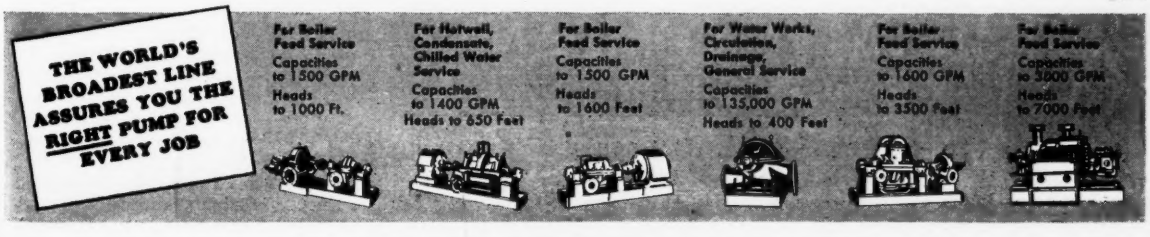
(To convert pressures in psi to feet of liquid, multiply by 2.31 and divide by specific gravity of the liquid at pumping temperature.)

WORTHINGTON

Worthington's Complete Line

of centrifugal pumps includes all pressures and capacities. For expert advice on any pumping problem — and further details proving *there's more worth in Worthington* — contact our nearest District Office. Or write to *Worthington Pump and Machinery Corporation, Centrifugal Pump Division, Harrison, New Jersey.*

C8-10


THE WORLD'S BROADEST LINE ASSURES YOU THE RIGHT PUMP FOR EVERY JOB
For Boiler Feed Service
Capacities to 1500 GPM
Heads to 1000 Ft.
For Hotwell, Condensate, Chilled Water Service
Capacities to 1400 GPM
Heads to 650 Feet
For Boiler Feed Service
Capacities to 1500 GPM
Heads to 1600 Feet
For Water Works, Circulation, Drainage, General Service
Capacities to 135,000 GPM
Heads to 400 Feet
For Boiler Feed Service
Capacities to 1600 GPM
Heads to 3500 Feet
For Boiler Feed Service
Capacities to 3000 GPM
Heads to 7000 Feet

TEMPERATURE REGULATORS

ATLAS

TRADE MARK REG.

Which do you want?

We offer the self-contained type, illustrated and described in Bulletin 7A. We also offer the hydraulically and pneumatically operated type—Bulletin 6A. For example, the following four are shown in Bulletin 7A:

ATLAS No. 650 is a Balanced Type Double Seat Valve. Spring Adjustment. For temperatures from 70° to 300° F. Bulb is immersed in liquid and control valve installed in steam supply. ½", ¾", and 1" for steam pressures up to 150 lb. 1¼", 1½", 2", and 2½" for steam pressures up to 100 lb. Operates in vertical or horizontal position.

ATLAS No. 651 is a Needle Type Single Seat Valve. Spring adjustment. For temperatures from 70° to 300° F. Used where tight seating valve is essential such as on small oil heater pump sets, open or closed tanks, sterilizers, glue heaters, etc. ½" and ¾" for steam pressures up to 150 lb. Operates in vertical or horizontal position.

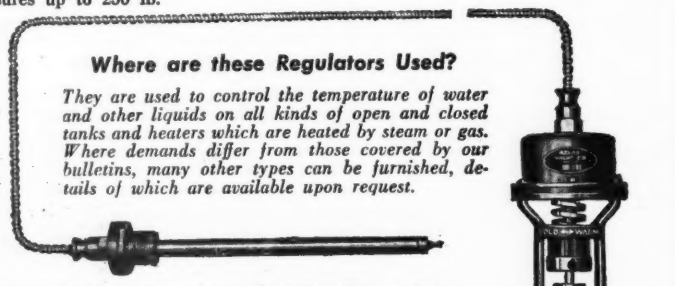
ATLAS No. 655 is a Balanced Type Double Seat Valve. Lever and Weight Adjustment. For temperatures from 70° to 300° F. Lever and weight adjustment of control valve assure high sensitivity. For maintaining temperature of liquids in all kinds of tanks and heaters. ½", ¾", and 1" for steam pressures up to 150 lb. 1¼", 1½", 2", 2½", 3", 4", 5", 6", and 8" for pressures up to 100 lb. Operates in horizontal pipes.

ATLAS No. 660 is a Single Seat Self-Contained Pilot Operated Valve. Spring Adjustment. For temperatures from 70° to 300° F. For use where accurate regulation demands a quick opening and tight closing control valve and where steam pressure is always 25 lb. or more, as for instantaneous heaters and tanks for water, oil, etc. ½", ¾", 1", 1¼", 1½", and 2" for steam pressures up to 300 lb. 2½", 3", and 4" for steam pressures up to 250 lb.

Write for Bulletin 7A giving detailed information

Where are these Regulators Used?

They are used to control the temperature of water and other liquids on all kinds of open and closed tanks and heaters which are heated by steam or gas. Where demands differ from those covered by our bulletins, many other types can be furnished, details of which are available upon request.



The Temperature Regulator shown here is No. 650. This, and the other self-contained temperature regulators covered in Bulletin 7A maintain perfect control of temperature of liquids. Each unit consists of a boiler and a motor consolidated into one machine. The control bulb is the boiler, and the vapor is generated by heating the thermostatic liquid contained within it. The pressure resulting is transmitted through capillary tubing to a one-piece metallic bellows, which, expanding, acts as the motor for operating the valve which regulates the admission of the steam or gas used to generate the heat. The control valves operated by bellows have seats suitable for the service.

- ☐ Temperature Regulators
- ☐ Damper Regulators
- ☐ Reducing Valves
- ☐ Exhaust Control Systems
- ☐ CAMPBELL Boiler Feed Water Regulators
- ☐ Pump Governors
- ☐ Pressure Regulators
- ☐ Oil Control Cocks
- ☐ Humidity Controllers
- ☐ Thermostats
- ☐ Balanced Valves
- ☐ Control Valves

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Check the items at the left on which you would like to have complete data and mail to us with your name, firm name and address.

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only if immediate steps are taken to establish commercial plants. He recommended that three or more commercial-size plants be built as prototypes now, using both coal and oil shale, to be built and operated by private industry with assistance, if necessary, by the RFC. Although synthetics are not here today, they will not be available five to ten years hence if development is permitted to lag today.

Another method for increasing the reserves of mineral resources of the country is by the sink-float technique for cleaning coal and concentrating ore, as explained before the meeting by John T. Sherman, mining engineer, American Cyanamid Co.

The Gas Turbine

H. D. Emmert of Allis-Chalmers Mfg. Co. discussed design of blades and blade paths for gas turbines, materials and design stresses in high temperature materials, blade stresses and blade frequency analysis.

Hot-spin tests of bladed jet engine rotors were reported by H. B. Saldin and P. G. DeHuff, Jr. of Westinginghouse Electric Corp. Effect of fuel properties on the performance of the turbine engine combustor was treated by Louis C. Gibbons and Edmund R. Jonash of Lewis Flight Propulsion Laboratory.

Carl Schabtach of General Electric Co. described how components of a gas turbine for locomotive drive, including a 15 stage axial flow compressor, 6 combustion chambers and a 2-stage turbine, were tested for such things as rotor stiffness and stability, blade dovetail strength, resistance to thermal cycles, diaphragm deflection and stress and the results tabulated and graphed.

Power Generating Gas Turbines

Details of a 5000-kw gas turbine generator for power generation, presented by Alan Howard and Chapman J. Walker of General Electric Co., were of great interest to the power engineers. This unit, now being manufactured, is designed for continuous operation at 1500 F turbine inlet temperature, burning Bunker C fuel oil and, with minor changes, able to burn practically any liquid or gaseous hydrocarbon fuel and, with no major redesign, to permit use of coal when combustion of this fuel has been sufficiently developed.

The unit, a two-shaft, open-cycle machine, consists of a constant speed high pressure turbine and compressor operating at 8694 rpm and geared to a 3600-rpm generator; low pressure turbine and compressor, which constitute a variable speed charging set; six metal combustors; one stage of inter-cooling; and a regenerator. The turbines are in line, the combustors discharging directly into the two-stage high pressure turbine and thence discharging directly in to the

THE VALVE THAT MAKES ORDINARY ZEOLITE SOFTENER AND FILTER EQUIPMENT OUT-MODED

THE introduction by the Cochrane Corporation of a remarkable single control valve as standard equipment on its well-known Zeolite Softeners and on its Pressure Filters makes the operation of the ordinary softener and filter system seem far out-moded. This Cochrane Hydromatic Single Control Valve speeds operations and insures accuracy of operation by integrating the functions of the usual valve nest in one single valve with four normal operating positions and two standby positions. All actions of the valve are smooth, positive and free from shock and the single lever turns with ease. Power is provided by the raw water itself through a pilot valve.

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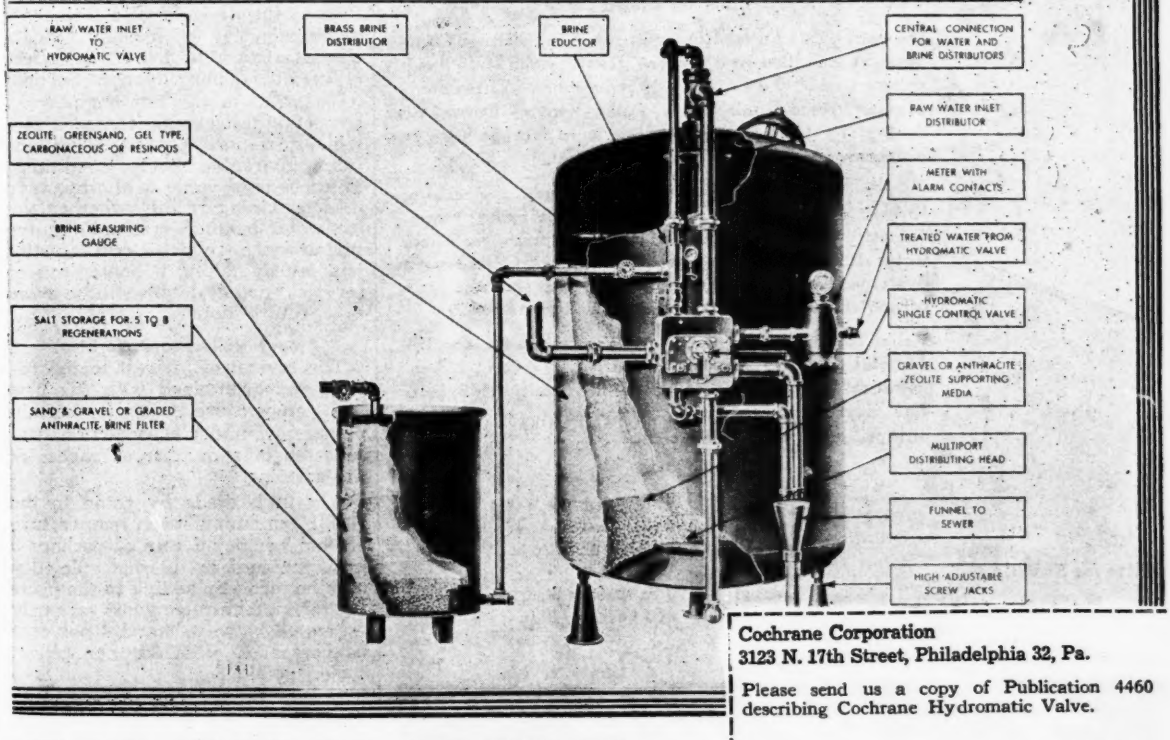
Cochrane Zeolite Water Softener with Hydromatic Single Control Valve


RAW WATER INLET TO HYDROMATIC VALVE
BRASS BRINE DISTRIBUTOR
BRINE EDUCTOR
CENTRAL CONNECTION FOR WATER AND BRINE DISTRIBUTORS
RAW WATER INLET DISTRIBUTOR
METER WITH ALARM CONTACTS
TREATED WATER FROM HYDROMATIC VALVE
HYDROMATIC SINGLE CONTROL VALVE
GRAVEL OR ANTHRACITE ZEOLITE SUPPORTING MEDIA
MULTIPORT DISTRIBUTING HEAD
FUNNEL TO SEWER
HIGH ADJUSTABLE SCREW JACKS
ZEOLITE, GREENSAND, GEL TYPE CARBONACEOUS OR RESINOUS
BRINE MEASURING GAUGE
SALT STORAGE FOR 5 TO 8 REGENERATIONS
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Please send us a copy of Publication 4460 describing Cochrane Hydromatic Valve.

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Two of its installations are shown above:

On land—Two Fuller Rotary Duplex Single-Stage Compressors installed in a cement plant. Each unit has a capacity of 2040 c.f.m., at 40-lb. pressure. These compressors furnish air for a Fuller-Kinyon Conveying System for transporting cement from storage silos to an ocean-going, cement-carrying vessel.

On sea—Three Fuller Rotary Single-stage Compressors, 'tween decks on the bulk cement-carrying vessel. Capacity of each unit 1560 c.f.m., 45-lb. pressure. These units furnish air for the Fuller-Kinyon Conveying Systems installed on board, which transport the bulk cement from ship to storage silos at destination.

Fuller Rotary Compressors are ideal units for any industrial plant, for capacities up to 3300 c.f.m., 125-lb. pressure. Thousands of users will verify this fact. The next time you need compressors, or vacuum pumps, get in touch with us.

Write for Bulletin C-5

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C-176

Fuller
A LIFETIME OF NEW MACHINE EFFICIENCY

single stage low pressure turbine with no high temperature piping between them. The unit is expected to produce a kilowatt hour for 0.7 lb of Bunker C fuel oil.

Details of the design of the combustion system for burning Bunker C oil in a gas turbine were described by Bruce O. Buckland and Donald C. Berkey of General Electric Co.

The gas turbine's place in the world power field was discussed by Walker L. Cisler of the Detroit Edison Co. at the Gas Turbine Power Dinner.

Power Plant Cycle Evaluation

Steam power engineers were much interested in the paper on power plant cycle evaluation presented by J. K. Salisbury of General Electric Co. This was a sequel to a previous paper outlining a method of analysis for steam power plant cycles. In the present paper, all heater systems are rated with respect to an ideal heater system and simple algebraic formulations permit determination of arrangement loss, distribution loss, and loss due to terminal differences and pressure drop in any heater cycle. Corrections for the cycle heat rate are described and two typical corrections are analyzed.

This analysis of cycles is of value, first, to the designer of a feedwater heating cycle, in selection of its characteristics, to know the effect of various minor changes. Second, it is useful to the test engineer in correcting test results for uncontrollable deviations of test conditions from guarantee cycle conditions. Third, it is of value to the operator in determining readily whether the feedwater-heating system requires maintenance which will justify temporarily taking a heater out of service. Further details will be given in a future issue.

Reheat Boilers and Turbines

The revival of interest in the reheat cycle combined with the new high temperature cycles for certain plants now under construction, was reflected in a number of papers at the meeting.

A gain is made by going to the 1050 F maximum steam temperature and an additional gain of perhaps 3 to 5 per cent in thermal efficiency may be made by adding to the cycle the reheat feature at a cost variously estimated between 2 and 4 per cent as compared with the non-reheat cycle.

In his paper Steam Generating Equipment for Resuperheating Cycles, Martin Frisch, Foster Wheeler Corp., discussed characteristics of these units, referring specifically to units in which the reheater surface is convection surface outside the furnace, although there may be some radiant primary superheat surface. Influence of fuel and furnace slagging is always important,

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For, with such a large number of units doing a cooling, heating or condensing job in practically every type of industry, Ross was able to make thoroughly conclusive observations. A definite trend became apparent in the selection of individual assemblies from standardized "BCF" parts. Thirteen sizes and sets of dimensions clearly established themselves as the needs of the majority, as did certain refinements in construction and advancements in thermal engineering gained through practical observations in the field.

Thus, with the will of the majority expressed, these most-wanted features have become standardized in the *new "BCF" All-Nonferrous Exchanger, now mass-produced for low unit cost, and continually stocked at the Ross plant for prompt shipment.*

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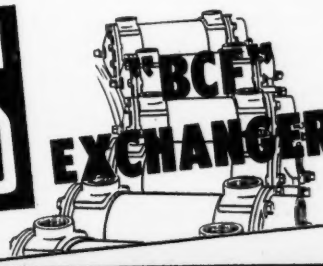

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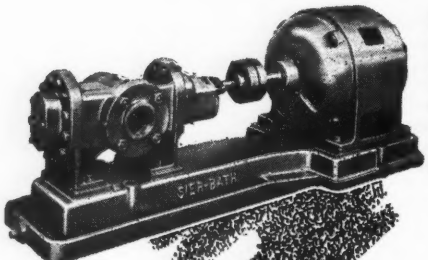
Sier-Bath Screw Pumps and Gearex Pumps are made in a modern plant under the best working conditions, by a company that has long been noted for the manufacture of precision gears. In the making of our pumps we adhere to the rigid standards of high quality that have made Sier-Bath Precision Gears famous among manufacturers of quality products. Send for booklet on Sier-Bath Screw Pumps or Sier-Bath Gearex Pumps.



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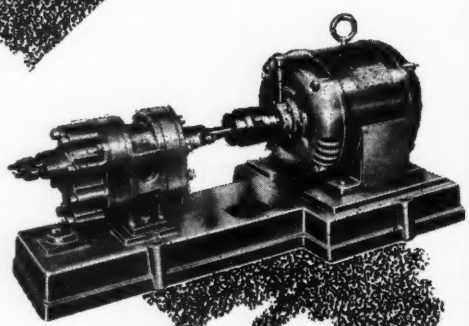
Advantages: balanced axial thrust, vibrationless operation, roller bushings for precision running under load. Pumps oils, varnishes, solvents, molasses, chemical solutions. Capacities 1-550 g.p.m. Discharge 250 p.s.i. for medium or high viscosities, 50 p.s.i. for water.



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whether reheat is used or not, and ash softening temperature is an important factor in operation.

He concluded that steam generators for resuperheating cycles cost little if any more than for non-resuperheating units and for small steam temperature control range may cost less. Resuperheating units with superheaters and resuperheaters entirely of the convection type are more difficult to design for low furnace exit temperature and are more restricted as to choice of fuel than the non-resuperheating units. Resuperheating units with radiant superheaters and resuperheaters are not so restricted in choice of fuel. Resuperheating units require little more skill to operate than non-resuperheating units.

In his paper on Developments in Resuperheating in Steam Power Plants, E. E. Harris of General Electric Co. reviewed the advantages of reheat and explained some of the characteristics of generating units. A difference of 50 deg between the initial and reheat temperatures changes the heat rate about 0.6 per cent for a usual temperature range they pointed out. The gain due to reheat was shown by curves and shows reductions of 6 to 7 per cent in heat consumption over non-reheat plants.

High pressure boilers with reheaters were also reviewed by W. H. Rowand, chief engineer, A. E. Raynor, executive assistant and F. X. Gilg, application engineer, The Babcock & Wilcox Co. This paper also analyzed the various factors in boiler design for reheat, for temperature control, using spray attemperators, influence of fuel and ash softening temperature, handling the unit during emergencies, protection of the equipment and facilities for restoring the load. Comparison of studies today indicate that a reheat boiler for 2035 psi, 1050 F and 1000 F reheat, costs about 7.5 per cent more than the non-reheat boiler for the same superheater outlet pressure and temperature.

Operating Experiences in Connection with Regenerative Reheat Turbine Installations were given by C. A. Robertson, Allis-Chalmers Mfg. Co. After reviewing the design details of several large 1800-rpm turbine tandem compound turbine generating units with regenerative reheat, the author discussed the protective equipment. By-pass and interceptor valves are used and other ideas have been advanced for eliminating the intercepting valves and substituting large steam unloading valves connected between the reheat line and the condenser.

Details of protective equipment tests were given and the paper covers experiences for 18 years. The various units have performed comparably with non-reheat units

located in the same stations and one 80,000-kw unit of late design in another station, supplied from a single boiler with a resuperheating section, has set the highest standard of performance in the industry, according to the author.

Construction details of steam turbines for resuperheat cycle were given by E. E. Parker of General Electric Co. This company has now under construction and on order at the middle of 1948 approximately 1,500,000 kw of nameplate rating for the resuperheat cycle. At present, there is installed in the United States approximately 2,460,000 kw in turbine capacity for the reheating cycle.

Reheat Turbine Design

The author described two types of reheat turbines, tandem and cross-compound, varying in rating from 50,000 to 125,000, currently being manufactured. The cross-compound type, with reheat between the 3600-rpm high pressure turbine and the 1800-rpm low pressure turbine at Philip Sporn, as recently described in these columns, was given.

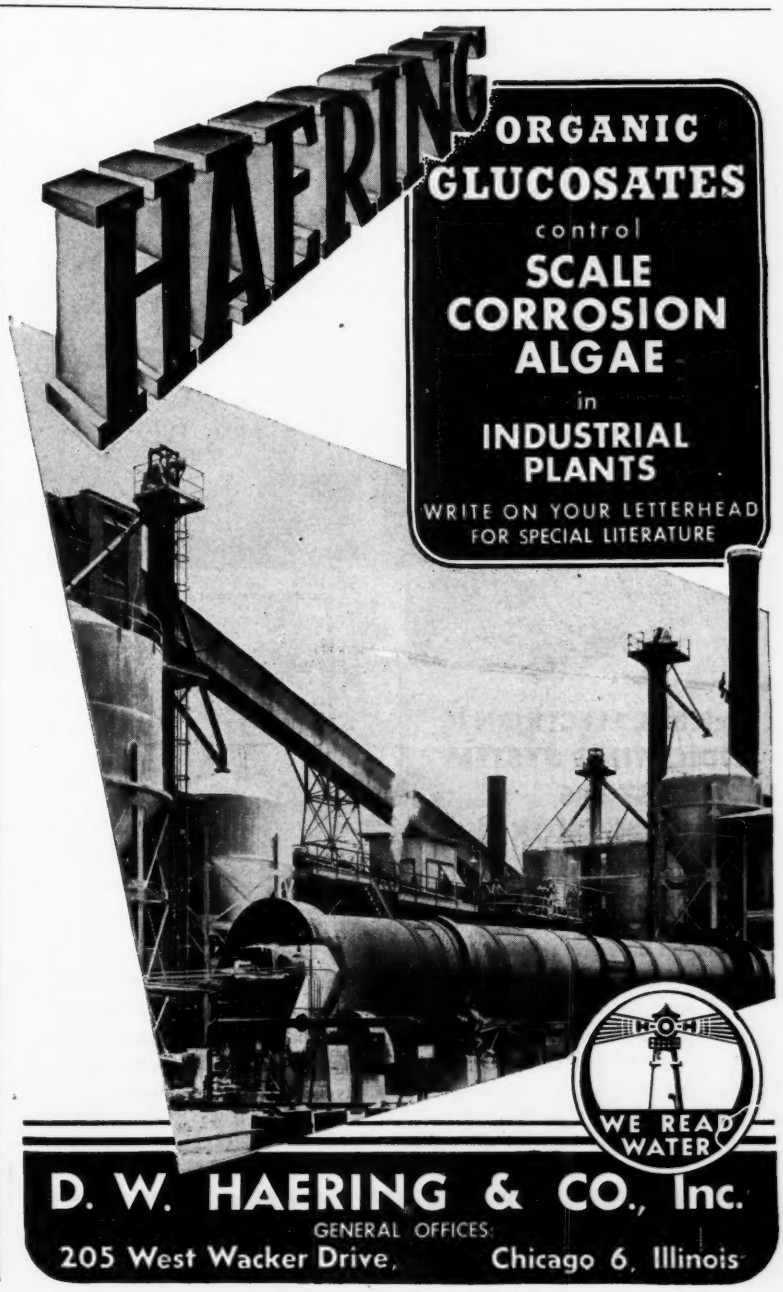
The author then described a recent development for a reheat tubine consisting of a 3600-rpm, tandem-compound, double-flow turbine, which resembles very closely the equivalent size non-reheat turbine. In this design, the high-pressure steam enters the turbine shell at mid-section and travels away from the generator. It is exhausted to the reheater at the forward end of the turbine adjacent to the No. 1 bearing standard and re-enters from the reheater immediately adjacent to the point at which the high pressure steam is admitted. Thus only one portion of the turbine shell is subjected to the high temperature of the initial and resuperheated steam, eliminating severe temperature gradients and moving the highest temperature portion of the shell and shaft away from bearings and water seals. Turbines of this type are under construction in ratings up to 100,000 kw, with steam conditions of 1450 psig, 1000 F initial and reheat to 1000 F; or 1250 psig, 950 F with reheat to 950 F.

Most of the speakers agreed that a 4 to 5 per cent decrease in station heat rate at same temperature and pressure levels is possible with the reheat cycle. Practically all the speakers agreed that the possibility of using the one-boiler-per-turbine design greatly simplifies the design, construction and control of reheat stations.

In a paper Modern Reheat Boilers, W. S. Patterson of Combustion Engineering Company, gave a brief resume of reheat progress followed by a discussion of the design factors that dictate the shape, size and proportions of a large reheat steam generator.

High-Temperature Piping

One interesting problem in the design of one of the newer high-temperature stations, which does not utilize reheat but is the first of the plants designed for 1050 F steam temperature to go into operation, was described by H. Weisberg, Public Service Electric and Gas Co. (N. J.). At Sewaren Generating Station of that company, the first two 100,000-kw turbines, just placed in operation, have been furnished with austenitic steel valves and inlet steam piping. The steam generating units, however, are provided with 3 per cent chrome, 1 per cent moly (ferritic) steel piping from the superheaters to the turbine. In the planning of the station, questions arose as to joining these dissimilar metals. Accordingly, the engineers of the utility, and United Engineers & Constructors together with those of GE, Westinghouse, Combustion Engineering and M. W. Kellogg Co. tested a joint known as the Kelcaloy joint for uniting these two metals. The paper reports cyclic heating tests of these joints and, as a result of them, concludes that sound welded joints can be made by this method that will withstand the effects of temperature changes that may be expected in modern power plant service.



Water Treatment

During the past decade certain cases of tube failures in ten power plants have indicated a type of attack on the steel somewhat different from the embrittlement previously studied. This has now been identified as hydrogen embrittlement and, though it is not widespread, must be explained. The entire subject was discussed by Everett P. Partridge, C. E. Kaufman and R. E. Hall of Hall Laboratories, Inc. in their paper on Hydrogen Embrittlement of Heat-Transfer Surfaces in Power Boilers.

Safety

Surveys of Typical Boiler and Machinery Accidents was a paper by Wm. D. Halsey of the Hartford Steam Boiler Inspection and Insurance Company. He emphasized the importance of eliminating the "chipmunks" present in the history preceding many accidents to power plant equipment. These are the unexpected or unforeseen factors that may cause or do relatively minor damage, yet if not found or removed may lead to more serious accidents. He gave a number of case studies of typical power plant accidents.

H. W. Heinrich of the Travelers Insurance Co. discussed Cause Analysis of Boiler & Machinery Accidents. Industry is handicapped by lack of factual information as to the causes of accidents. In turn this is due to lack of a suitable code whereby the pertinent facts may be recorded. Such a code has now been developed and is described in Mr. Heinrich's paper. It comprises three mutually-exclusive cause factors, items within these factors and definitions devised to cover all causes of accidents to all types of boilers and machinery.

Boiler Problems

An interesting engineering application of scale model study of the combustion air distribution for a proposed boiler installation was described by R. A. Lane of Philadelphia Electric Co., and E. L. Morrison of the Babcock & Wilcox Co. This was an actual model of the Southwark Station boiler duct work, burners and primary furnace, constructed to determine the flow pattern through the secondary air duct, air distribution through the wind box and burners, and the probable gas flow inside the furnace. On the basis of these model tests, certain modifications were made in the full size unit, and these were afterward compared and an interesting series of motion pictures were taken during the actual performance in the furnace.

Studies on Fly Ash Erosion were reported by M. A. Fisher of Armour Research Foundation and E. F. Davis of Institute of Gas Technology. This work was primarily concerned with the probable effect of fly ash in certain projected gas turbines. Deposits produced at high temperatures consisted of a hard ceramic like material ranging in color from a light tan through various shades of reddish brown to a dark red almost black color. General appearance and properties of the high temperature deposits suggested that the fly ash particles were actually sintered together, even at temperatures as low as 800 F. Although the deposits usually adhered to the underlying metal, it was possible to remove them either by blasting with ordinary fly ash, or by chemical methods.

Small Plants

Combustion Ash Collection for the Small Power Plant was covered by Philip F. Best of the Thermix Corporation. The small power plant has been much neglected in its dust collection systems. Factors in emission from small stoker fired installations, study of the characteristics of the ash and how it travels are given in the paper, and relation of stack emissions to product contamination, wear on fans, influence of smoke and dust codes, etc., were reviewed.

Detailed study of how to cut small power plant costs by mechanical

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coal and ash handling was presented by C. E. Miller, H. M. Carlson, and R. B. Engdahl of Battelle Memorial Institute. This analyzed the use of simple coal and ash handling equipment in various types of small boilers of 30 to 90 hp, another group for 150 hp plants and again for 225 to 300 hp boiler plants. Tables of estimated costs of operation for various conditions were presented to show the savings in operating costs resulting from the use of this equipment.

Of great interest to power engineers was the symposium on progress in automatic control of steam plants, devoted principally to a discussion of the advantages of centralized control in steam plants. Such centralized control is being adopted in many of the new stations now being designed and constructed, although the idea is not new and has been used occasionally in previous years. Further details of this symposium will be given in a future issue.

Nuclear Energy

Another important session for power engineers was that on industrial uses of heat energy from nuclear fission. Chairman of this meeting, Alex D. Bailey, Chairman of the ASME Nuclear Energy Applications Committee, sounded a warning note as to the work to be done before energy from nuclear fission can be used for industrial power. Commissioner Sumner Pike of the Atomic Energy Commission said that before we can get power from high temperature by-product heat of an atomic reactor, we must locate a structural material for the pile that will stand the high temperature, find an effective coolant, work out ways to dispose of the "garbage," and locate a good supply of uranium ore.

Engineers and industrial leaders were urged by James W. Parker of Detroit Edison Co., Chairman of the Industrial Advisory Committee to the AEC, to do some calculations to determine what use could be made of high temperature heat, either directly or as power, and to place a dollar value on it to help the AEC determine relative costs.

Dr. John J. Grebe, Dow Chemical Co., was optimistic on the possibilities for nuclear heat energy, but pointed out that because of plentiful supplies of coal and lower grade fuels the compulsion to proceed with nuclear research and development is lacking, whereas in foreign countries faced by fuel shortages, they have the know-how and are forced to get behind this development. That lack of compulsion, said Dr. Grebe, may lull us to sleep so that in 20 or 30 years, instead of being leaders, we'll be also-rans.

Dr. James B. Fisk of Harvard University explained in some detail why the energy in one pound of Uranium 235 is equal to approximately 1500 tons of coal and Captain H. G. Rickover of the Bureau of Ships, U. S. Navy, explained the Navy's desire to do away with the requirements for ordinary fuels and ships and use atomic power plants. The Navy, said Capt. Rickover, is attempting to see that work on coolants or heat exchangers, such as liquid metals, gases and steam and water, is going along simultaneously; GE is now carrying on research with liquid metals.

Annual Awards

During the meeting, E. G. Bailey conferred three ASME awards on young engineers for outstanding papers on engineering subjects. The Charles T. Main Award was granted to E. Duane Stewart, mechanical engineer with the West Virginia Pulp and Paper Co. Thomas L. Dinsmore, instructor in mechanical engineering, Princeton University, received the Postgraduate Student Award. The Undergraduate Student Award was conferred on Leroy W. Ledgerwood, Jr., Oklahoma A. and M. College.

At the Annual Dinner, the Society conferred its national honors and awards on the following: Dr. Frederick G. Keyes, head of the department of chemistry, Massachusetts

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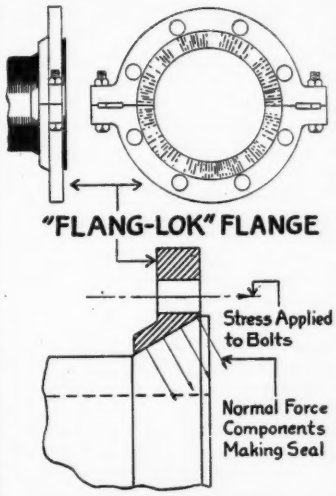

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Institute of Technology, was awarded the ASME Medal for distinguished service in engineering and science. Edward Smith Cole, president of the Pitometer Log Corp., was awarded the Worcester Reed Warner Medal, for his contributions to the methods of measuring the flow of water in conduits and the speed of ships. The Holley Medal, for scientific and engineering achievement, was bestowed on Edwin H. Land, president of the Polaroid Corp., for his great and unique work in polarized light and optics, original research and development of war weapons, and many accomplishments for the public benefit. Dr. Theodore von Karman, one of the world's most eminent scientists in the field of applied mathematics, received the John Fritz Medal, a joint award of the four engineering "founder" societies. Dr. von Karman has played a significant role in the development of jet propulsion, supersonics, ballistics, long range rockets, and in many fields of physics and mathematics.

Reginald E. Gillmor, vice chairman of the National Securities Resources Board, former president of Sperry Gyroscope Co., received the Melville Prize Medal. The society's Junior Award went to 28-year-old Hunt Davis, aerodynamics division engineer, research and development department, Elliott Co. The Pi Tau Sigma Medal went to Walter G. Vincenti of the Ames Aeromautical Laboratory.

NEWS *from* THE FIELD

The Fred H. Schaub Engineering Co., Inc., Chicago, Illinois, announces the appointment of Mr. Frank T. Settle, as field sales engineer for all Schaub products and equipment. Mr. Settle was connected with the General Tire and Rubber Co., of Akron, for the past ten years as a Kraft engineer and later as sales manager in the Rocky Mountain Division. He is a graduate of Columbia University, New York City.

Announcement has been made by Oakite Products, Inc., New York, of the appointment of Frank L. Oldroyd as Sales Manager of its Industrial Division. Mr. Oldroyd has been associated with the Oakite organization for over fifteen years, having spent eleven of these years as an Oakite field service territorial representative in various sections of the country. Subsequent promotions found him acting in the capacity of Division Manager in the company's divisional offices in Atlanta and Chicago for a period of two and one-half years, then as special Field Sales

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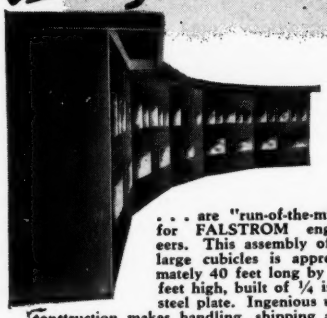

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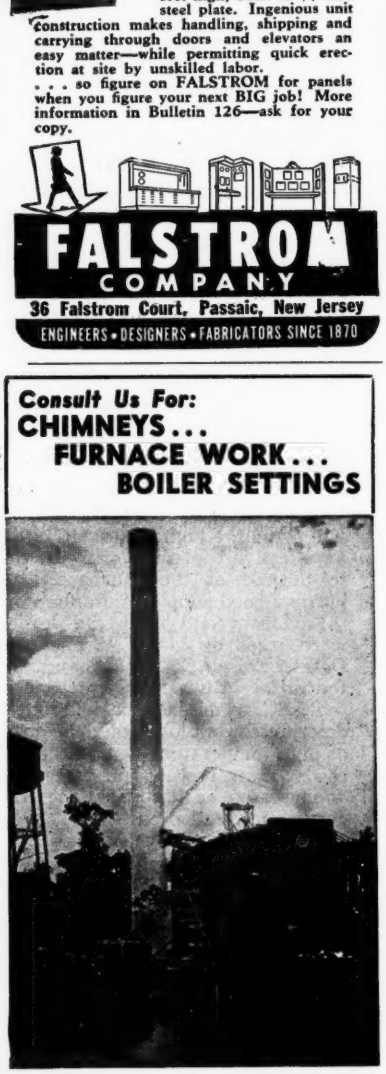

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Manager for a year prior to his most recent appointment.

Bids have been submitted to Illinois Institute of Technology for the construction of a $675,000 heating plant, newest structure in the institute's $15,000,000 development program, it was announced recently by President Henry T. Heald. Plans call for the new heating plant and its auxiliary units to be completed and in operation by the fall of 1949. It will eventually serve the entire 100-acre south side campus.

W. W. Kuyper has been appointed Divisions Engineer of the Turbine, Generator and Gear Engineering Divisions of General Electric River Works, Lynn, it has been announced by G. B. Warren, Manager of Engineering of those divisions. He succeeds K. M. Holt who is retiring after more than 40 years of service to the company.

Announcement was made at the same time of the retirement of E. N. Twogood as Division Engineer of the Gear Engineering Division. Mr. Twogood has been with General Electric for more than 38 years, originally joining G.E. in 1910 after his graduation from the University of California. L. J. Collins has been appointed to succeed him. Mr. Collins, a Californian and a graduate of the University of Nevada, joined G.E. in 1929. During the war he was a member of a Navy Technical Mission in Europe.

Mr. J. J. Zrodowski has been appointed Designing Engineer of the Gear Engineering Division. A native of Schenectady, N. Y., Mr. Zrodowski studied at Lowell Institute and is a graduate of the G-E Apprentice Course. He was active during the war in co-ordinating the design and manufacture of Navy and Merchant propulsion gears between manufacturers of the Navy and Maritime Commission. He has been with General Electric since 1916.

Dr. Pio Franco Martinuzzi has been appointed a professor of mechanical engineering at Cornell University, President Edmund E. Day announced. Dr. Martinuzzi, who is now traveling in Europe, will join the staff in February. He was formerly associated with Giulio Cesare Cappa, Italian engine designer; Sunbeam Motor Car Co., Ltd., England, and other European firms, and was active in the design of the Coatalen diesel engine.

Worthington Pump and Machinery Corp. announces that beginning November 29, 1948, the manufacturing and distributing activities of its subsidiary, Ransome Machinery Co., will be conducted by the parent corporation.

R. R. Donaldson, is Hagan Corporation's new vice president in charge of engineering. He rose through the ranks, first to the job of chief engineer of the Hagan service department, then assistant chief engineer, Hagan Corporation; next—in 1946—as acting chief engineer, and last year became chief engineer.

M. J. Boho has been elected vice president in charge of sales, Hagan Corporation, Pittsburgh combustion control and flow meter manufacturer. Mr. Boho joined Hagan as a field service engineer in 1936, after serving as a research engineer in private industry and with the Potomac Electric Power Co., Washington, D. C. In 1938 he was transferred to Hagan's New Projects Division, where he was engaged in the development, design and application of automatic combustion controls for steel industry use. In 1945 he was appointed assistant general manager of sales.

HARALD M. OLSON has been named Consulting Maintenance Engineer for the Morton Salt Co., Chicago Illinois General Office, starting January 1, 1949. Mr. Olson will be available for Consultation thru Morton Salt Co. on any new projects and also on any trouble problems that may need attention in the exchange field or equipment in service. Mr. Olson will continue his activities as General Chairman of the Annual Industrial Water Conference of the Engineers Society of Western Pennsylvania, Pittsburgh, Pennsylvania, as he has since its inception in 1940.

New ENGINEERING BOOKS

Atomic Energy by Karl K. Darrow, First edition, 80 pages, 5½ by 8½ in., cloth, illustrated, published by John Wiley and Sons., Inc., 440 Fourth Avenue, New York 16, New York, Price $2.00.

Almost everyone has read an article or a book or heard a speech or a radio broadcast dealing with atomic energy. Your newspaper carries articles daily on the political problems involved, your favorite magazine tells you, for example, how atomic energy will soon be utilized in medicine. In this particular publication many articles on atomic energy have appeared dealing with its use for power purposes.

Regardless of the fact that while atomic energy may not be used for the production of power in the near future it must be recognized that our education in atomic or nuclear science should not be neglected. Some scientists would have our education speeded up because they realize that so few of us are really aware of all the implications of atomic energy. The popularization of this amazing force has necessarily stressed the destructive aspects, yet it is tremendously important to know that this mysterious power may be used to run the power plants of this country, or through the use of radioactive isotopes may eliminate the starvation and malnutrition affecting so many of the earth's inhabitants. A member of the United States Atomic Energy Commission recently warned the public that the future of the world rests upon our ability to form and enforce intelligent opinion on the subject.

To help all of us realize the true significance of atomic energy, the essential facts of the scientific background, development, and potentialities of this powerful discovery are offered to us by an outstanding American physicist, Karl K. Darrow, in this excellent little book. This clearly and conversationally written little volume is based on the popular Norman Wait Harris lectures delivered by Dr. Darrow at Northwestern University last year. Although only 80 pages long it fully covers the salient points of its subject.

Beginning with a discussion of the atom, the author gives a lucid explanation of its structure, concentrating on the important role of the nucleus. Then gradually building up to more complex subjects, he proceeds to tell about nuclear theory, isotopes, transmutation, chain reaction, radioactivity, and other aspects of atomic energy. Simple and interesting analogies describe confusing terms like "free neutron" or "sinister nuclei," so that the average non-scientific reader has an easy to read picture throughout.

Dr. Darrow, currently associated with the Bell Telephone Laboratories in New York, is an internationally famous author, lecturer, and scientist. For the people, therefore, who want an authoritative yet easily understandable guide to the technical essentials of this subject, this little book by Karl Darrow is the answer. This narrative of the basic facts most pertinent to the transformation of mass into energy is strongly recommended to all who are concerned with the future of the world.

• • •

Thermodynamics by Edward F. Obert, First edition, 571 pages, 6 by 9 in., cloth, illustrated; published by the McGraw-Hill Book Company, 330 West 42nd Street, New York, New York, 1948; Price $5.50.

This book was written to serve as a fundamental text in the field of thermodynamics and heat power. The book presents an unusually detailed and comprehensive treatment of the subject with emphasis on the logical development and application of the science of thermodynamics. The presentation is sufficiently rigorous and complete to satisfy the student and to serve as an introduction to more **advanced topics.**

More complete than most other text in the field, the book offers adequate material on air conditioning, refrigeration, gas turbine, etc., so that specialized courses in these fields are unnecessary in the undergraduate curriculum. An aim of the book is to provide certain essential material that must be understood by the practicing engineer and considerable stress is placed **upon real machines, flow processes and** properties of fluids. The illustrations are drawn in a manner to aid in the solution by emphasizing the concepts of the system and the surroundings.

As explained in the preface, the author had several reasons in mind for writing the book. The first objective was to present and emphasize certain essential material that must be thoroughly understood by the practicing engineer. The second objective was to emphasize the continuity of thought leading to the second law of thermodynamics. To accomplish this purpose the first law, its application and its limitation are stressed before the second law is introduced. While study of the characteristics of fluids is delayed until after the significance of the concepts of temperature and entropy are presented. The third objective of the text is to show that for many real fluids and for many real processes the simple perfect gas laws are inadequate and most desirable means of analysis at least for engineers who use slide rules for computations. To accomplish this purpose the properties of real fluids are presented and approximate solutions are studied before the concept of a perfect gas is introduced. Moreover, the comparison between real and perfect gases is stressed.

The kinetic theory is used as a logical means of introducing the student to the characteristics of real gases. The flow of fluids has been emphasized because the problem of fluid flow is one of the most usual tasks that the practicing engineer is called upon to treat. For the same reason irreversible processes are also stressed.

Without question this is one of the most complete books on thermodynamics published in recent years.

• • •

The Application and Care of Rubber Protective Equipment. Edison Electric Institute, 420 Lexington Avenue, New York 17, N. Y.; Price 25 cents per copy.

Safe handling of electric lines and safety insurance against shock and burn accidents in work areas through the proper use of rubber protective equipment are described in this book, a 31-page safety man-

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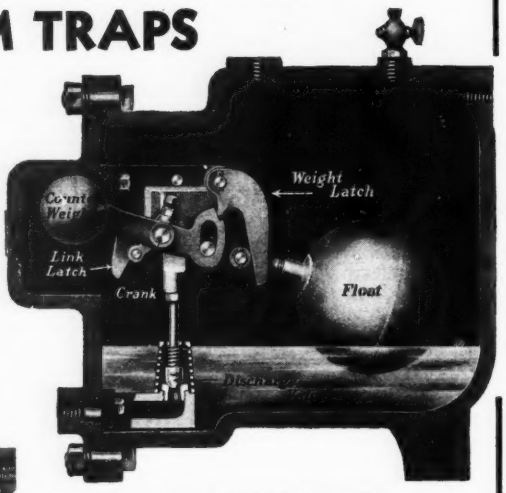

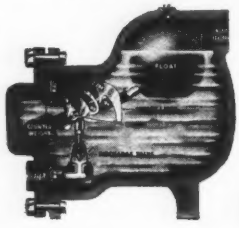

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ual just published by the Accident Prevention Committee of EEI. The new booklet, a companion piece to the previously published Use and Care of Pole-Climbing Equipment, is one of a series of manuals being prepared for the electric industry by the Committee.

Over fifty photographs clearly showing the use and maintenance of the various types of rubber protective equipment form the dominant feature of the manual, and were carefully prepared in the field under Committee supervision. Fully complementing the illustrations, the text is comprehensive and concise.

Emphasis is placed on making the proper application of rubber equipment an integral part of each job. Rubber gloves, sleeves, line hose, insulator hoods, shields, and blankets are carefully described, and their proper place in the pattern of work is explained. Methods of application and hazards to be avoided are detailed; and the proper procedure in removing the equipment after the job is done is laid down.

Pointers on the handling and storage of the different types of equipment, and their maintenance and inspection, complete the manual.

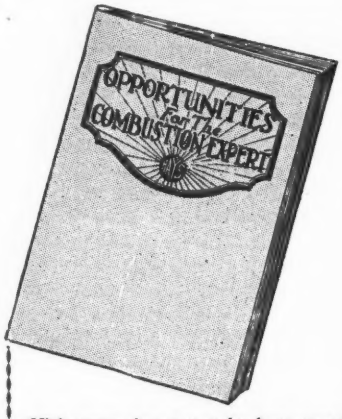
• • •

Electric Motor Maintenance by W. W. McCullough. Size 5½ by 8½ in.; 120 pages, illustrated. Published by John Wiley & Sons, Inc., 440 Fourth Avenue, New York 16. Price $2.00.

A highly practical book or manual by a service engineer of long experience in the manufacturing and repair department of Westinghouse Electric Corp.

The book is divided into three sections with a total of 16 chapters. The first, covering mechanical maintenance, deals with motor assembly, bearings, current collecting devices and air gaps. The second part, dealing with electrical maintenance, discusses insulation, materials, cleaning and drying and testing. The third part, dealing with maintenance and application, considers various types of motors, their proper application and use. There is a chapter on electric couplings.

While the book is written in concise, clear, sometimes elementary language, it is not a step-by-step guide for the apprentice or inexperienced worker. Rather it is a broad but complete treatise on motor maintenance, well adapted to the use of super-



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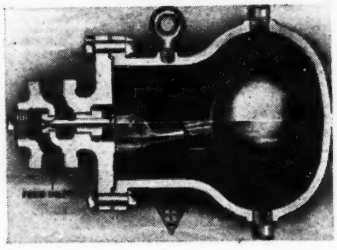

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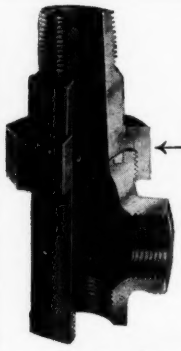

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visors or inspectors as a working outline of points that must be considered in the use, application and repair of motor equipment, if good performance is to be expected.

• • •

Concrete Production and Control — TVA Projects. Size 6 by 9 in.; 350 pages; cloth bound. TVA Technical Report No. 21. Published by the Superintendent of Documents, Washington, D. C. Price $1.50.

This volume is a record of the more important facts concerning concrete use and control achieved in the erection of the structures built as a part of the general program of the TVA. The first 60 pages deal with the preliminary investigations and the production of concrete material. The next 100 pages deal with concrete design, production, placing, mixing and temperature control. This is a highly practical record of on-the-job practice. The next 60 pages deal with special tests and studies on such matters as slag aggregates, volume changes, hardening rates, flexure tests, sand-blanket construction, joint treatment, tests on absorptive form liner, time for form stripping, effect of freezing and low temperatures, spoiling, and the like.

From the power engineer's standpoint, probably the most valuable section is the 100 odd pages in the appendix. These cover cement specifications and instructions to concrete inspectors, report forms, laboratory equipment used, sampling methods and correlation of data from different projects. The book has a total of 223 well-selected illustrations.

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Single-Phase Motor Starting Current Rules. Size 8½ by 11 in.; 6 pages. EEI Publication No. Q-8. Published by the Edison Electric Institute, 420 Lexington Avenue, New York City. Price 25 cents.

This pamphlet is a report of the Joint Committee on Motor Starting Currents and consists of two parts. Part I, 3 pages, consists of single-phase motor starting current rules; and Part II, the Appendix, gives the bases of the recommendations of the discussion of voltage flicker due to motor starting and the effect of motor starting currents on permissible secondary lengths, and relative costs of distribution system designed to limit flicker.

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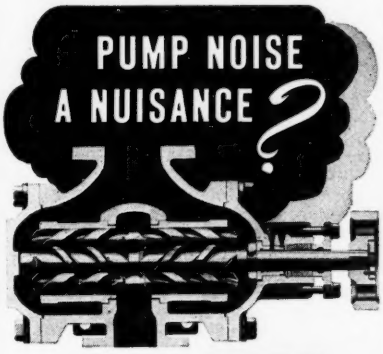

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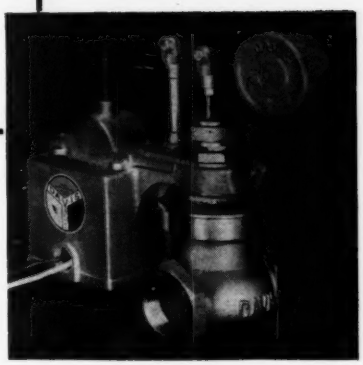

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POWER PLANT Construction News

Birmingham, Ala.—Alabama Power Co., 600 N. 18th St., will make extensions in generating stations to provide gross increase in capacity of 285,000-kw during next 36 mos., including work now in progress. Of this amount, about 140,000-kw is expected to be available by close of 1949, and remainder during 1951. Contract is being let for structural steel framing for addition to generating station at Gorgas, Ala., and work will begin soon.

Tucson, Ariz.—Arizona Portland Cement Co., Tucson, recently organized, care of Fisher Contracting Co., S. 19th Ave., Phoenix, Ariz., plans power house at new cement mill at Rillito, near Tucson, where large tract of land has been secured. Project will comprise a number of buildings, and is reported to cost close to $1,200,000, including machinery. Fisher company, noted, has contract for construction.

Torrance, Calif.—Pittsburgh Plate Glass Co., Paint Division, Grant Bldg., Pittsburgh, Pa., paints, varnishes, oils, etc., is reported planning boiler house at proposed new multi-unit plant at Crenshaw Blvd., and 203rd St., Torrance, near Los Angeles. Entire project is estimated to cost approximately $1,000,000. Albert C. Martin & Associates, 333 S. Beaudry Ave., Los Angeles, are architects and engineers.

Whiting, Ind.—Carbide & Carbon Chemicals Corp., synthetic organic chemicals of various kinds, plans new steam-electric generating plant at local factory, reported to cost close to $1,750,000, with equipment. Work will be placed under way soon. Day & Zimmerman, Inc., Packard Bldg., Philadelphia, Pa., is engineer and will supervise construction.

Kansas City, Kan.—International Harvester Co., 180 N. Michigan Ave., Chicago, Ill., agricultural machinery, motor trucks, etc., plans boiler house at proposed new sub-assembly works and parts plant in Fairfax industrial district, Kansas City, where tract of over 30 acres of land has been acquired. Work is scheduled to begin next spring. Entire project is reported to cost in excess of $7,500,000.

Henderson, Ky.—Municipal Light Dept., Fourth and Elm Sts., has plans maturing for new municipal steam-electric power plant, to supplement present station. Cost estimated about $3,000,000. Bond issue in that amount is being arranged. Black & Veatch, 4706 Broadway, Kansas City, Mo., are consulting engineers.

Louisville, Ky.—Louisville Gas & Electric Co., 311 W. Chestnut St., is arranging an expansion and improvement program in plants and system to be carried out over period of months, estimated to cost about $29,000,000. Work will include extensions in generating stations, power substations, transmission lines, distribution systems, and other operating facilities.

North Baton Rouge, La.—Ethyl Corp., compound lead fluids (tetraethyl) for high-test gasoline manufacture, plans expansion in power house for service at new production unit at local plant, comprising several additional buildings for processing and general production. Entire program will represent a reported investment of about $10,000,000, and is scheduled to be placed under way early in 1949.

Cumberland, Md.—Kelly-Springfield Tire Co., automobile tires and tubes, plans extensions and improvements in power plant at mill, with installation of additional equipment for increased capacity. Cost reported close to $850,000. Sargent & Lundy, 140 S. Dearborn St., Chicago, Ill., are consulting engineers.

Vienna, Md.—Eastern Shore Public Service Co., Salisbury, Md., has approved plans for expansion in steam-electric generating station at Vienna, including addition to building and installation of new turbine-generator, high-pressure boiler and auxiliary equipment. Cost reported about $5,000,000. Work will begin soon. United Engineers & Constructors, Inc., 1401 Arch St., Philadelphia, Pa., is engineer.

Elk River, Minn.—Rural Cooperative Power Assn., Maple Lake, Minn., has plans in progress for new steam-electric generating station at Elk River, to be equipped for an initial capacity of 11,500-kw. Cost estimated about $2,500,000. At later date, two additional turbine-generators and auxiliary equipment will be installed, making ultimate cost of approximately $5,000,000 for plant. Work is expected to begin early in 1949. Ralph D. Thomas & Associates, Inc., Metropolitan Life Bldg., Minneapolis, Minn., is consulting engineer.

Red Wing, Minn.—Northern States Power Co., 2 S. Barstow St., Eau Claire, Wis., is considering construction of new steam-electric generating station in vicinity of Red Wing. Estimates of cost will be made soon.

Jackson, Miss.—Mississippi Power & Light Co., Lampton Bldg., has authorized an expansion and improvement program to cost about $27,000,000, over a period of months, work to include generating stations, power substations, transmission lines and other operating facilities. Financing is being arranged in amount of $7,500,000 as part of fund for immediate work.

Natchez, Miss.—Southern Kraft Division, International Paper Co., Mobile, Ala., kraft and other papers, plans power plant at new rayon pulp mill on tract of about 1000 acres of land on Mississippi River, near Natchez, now being acquired. Also will build pumping station and water-treatment plant. Project will consist of a number of processing and production buildings, and is reported to cost close to $20,000,000. Proposed to begin work early in 1949.

Charlotte, N. C.—Duke Power Co., 422 S. Church St., has made application for permission to arrange financing for expansion and improvements in plants and system, including proposed new steam-electric generating station on Dan River, near Leaksville, N. C., previously referred to in these columns, estimated to cost close to $15,000,000. New power plants are planned also at Spray and Cliffside, N. C.

Painesville, Ohio—City Council is considering plans for extensions and improvements in municipal steam-electric power plant, with installation of equipment for increased capacity. Cost reported about $350,000. It is understood that work will be carried out soon.

Hershey, Pa.—Hershey Chocolate Co., has plans for extensions in boiler house at chocolate products factory, with installation of additional equipment for increased capacity. Award is being made for structural steel framing and work will begin soon. No estimate of cost announced.

West Mifflin, Pa.—Fisher Body Division, General Motors Corp., General Motors Bldg., Detroit, Mich., automobile bodies, plans power house at proposed new plant on Camden Hill Rd., West Mifflin, vicinity of Pittsburgh, where large tract of land has been purchased. Plant will comprise several buildings, equipped primarily for steel stamping for body production. Entire project will cost close to $5,000,000.

East Providence, R. I.—First National Stores, Inc., 5 Middlesex Ave., Somerville, Mass., food products, plans boiler house and refrigerating plant at new central storage and distribution plant on Ferris Ave., East Providence. It is understood that bids for erection will be asked early in 1949. Cost estimated close to $1,000,000. Ganteaume & McMullen, 99 Chauncy St., Boston, Mass., are architects and engineers.

Charleston, S. C.—South Carolina Power Co., 141 Meeting St., has plans for new addition to steam-electric generating station, with installation of additional equipment for increased capacity, including turbine-generator, high-pressure boiler and accessories. Award is being made for structural steel framing, and work will begin early in 1949. No estimate of cost announced. Gilbert Associates, Inc., 412 Washington St., Reading, Pa., is consulting engineer.

Greenville, S. C.—Maverick Mills, Inc., 144 Addison St., East Boston, Mass., fine cotton goods, plans installation of boiler house at proposed new mill on 100-acre tract of land near Greenville, recently acquired. Entire project will comprise a number of mill units and is reported to cost close to $4,000,000. Work scheduled to begin early in 1949.

Beaumont, Texas—Gulf States Utilities Co., 362 Liberty Ave., has tentative plans for expansion and improvements in local Neches steam-electric generating station, with installation of turbine-generator, high-pressure boiler and auxiliary equipment. Cost estimated about $4,000,000.

Belton, Texas—Brazos River Transmission Electric Cooperative, Inc., Amicable Bldg., Waco, Texas, has plans under way for new hydroelectric generating station in vicinity of Belton, reported to cost close to $650,000. Laramore & Douglass, Inc., 79 E. Adams St., Chicago, Ill., is consulting engineer.

Dallas, Texas—Dallas Power & Light Co., 1506 Commerce St., plans new steam-electric generating station near eastern city limits, to be equipped for initial capacity of 60,000-kw. Cost estimated about $8,200,000, with power substations, transmission lines and other operating facilities.

Laredo, Texas—Central Power & Light Co., Corpus Christi, Texas, plans expansion in gas engine-operated generating station at Laredo, with installation of equipment for increased capacity. No estimate of cost announced. Company engineering department in charge.

Manitowoc, Wis.—Board of Public Utilities, 817 Franklin St., plans extensions and improvements in municipal steam-electric generating station during next 24 mos., work to include addition to steam department and installation of boiler and accessories, to cost about $740,000; two new concrete stacks, $200,000; coal-handling equipment, $175,000; ash disposal equipment, $50,000; and extensions in lake water intake, $200,000. R. E. Cannard is general manager.

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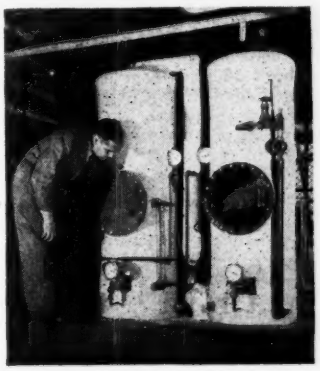

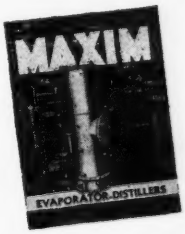

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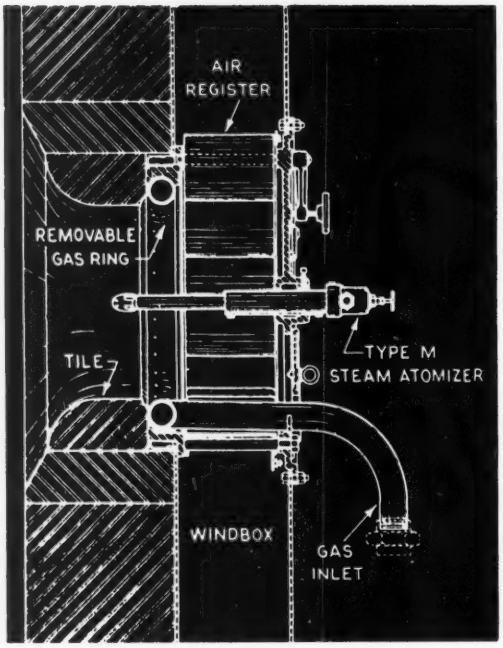

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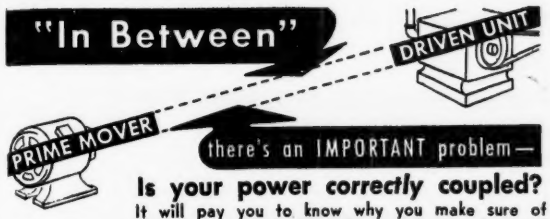

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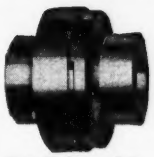

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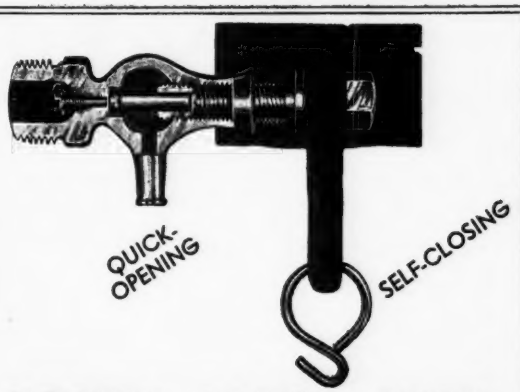

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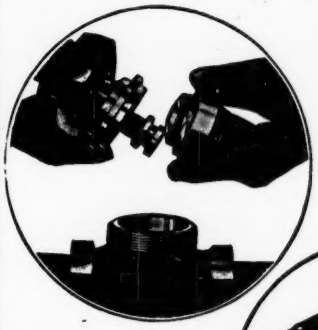

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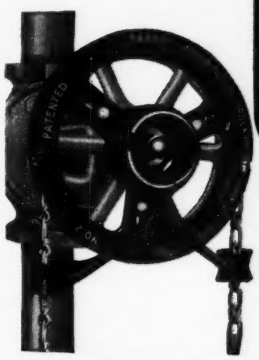

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American Chimney Corp. 124
American District Steam Co....100
American KAT Corp. ..... *
American Pulverizer Co. 30
Arkansas Fuel Oil Co. 33
Armstrong Machine Works 45
Atlas Valve Co. 116

Babbitt Steam Specialty Co.....131
Baker Co., How E. ..... *
Beaumont Birch Company ..... *
Belco Industrial Equipment Division, Inc. 124
Belmont Packing & Rubber Co... *
Betz, W. H. & L. D. 93
Bird-Archer Co., The 105
Bros Boiler and Mfg. Co., Wm...107
Buell Engineering Company.... *

Cambridge Instrument Co. ..... *
Chapman Valve Mfg. Co., The .....Inside Back Cover
Cities Service Oil Co. 33
Clipper Mfg. Co. ..... *
Cochrane Corporation 117
Combustion Engrg. Co., The 14-15
Crane Co. 43

Dampney Co. of America, The.. *
Dart Mfg. Co., E. M. 112
Davis Regulator Co. 127
Dearborn Chemical Co. ..... *
DeLaval Separator Co., The....110
DeLaval Steam Turbine Co...32, 127
Detroit Stoker Co. 26-27
Dollinger Corporation 40
Dominion Chemical Co., Inc..... *
Dowell, Incorporated 37
Drew & Co., E. F. ..... *
Dudgeon, Inc., Richard ..... *

Edward Valves, Inc. 38-39
Elliott Co. 2-3
Engineer Co., The ..... *
Enterprise Engine & Foundry Co. *
Erie City Iron Works 103
Ernst Water Column & Gage Co..101
Everlasting Valve Co. ..... *

Falstrom Company 124
Fisher Governor Company 18
Foster Engrg. Company ..... *
Foster Wheeler Corp. 20-21
Fuller Company 118

Garlock Packing Co., The 28
General Coal Co. ..... *
General Electric Co. ..... *
Gifford-Wood Co. 19
Golden-Anderson Valve Specialty Co. 129
Goodall Rubber Co., Inc. 123
Graver Tank & Mfg. Co., Inc... *
Green Fire Brick Company, A.P. *
Grinnell Co., Inc. 47
Griscom-Russell Co., The ..... *

Haering & Co., Inc., D. W. 121
Hagan Corporation 12-13
Hall Laboratories 22-23
Hays Corporation, The 114
Hays Institute of Combustion....126
Huyette Co., Inc., The Paul B.. 131

Infilco, Incorporated ..... *
Ingersoll-Rand Co. 98
International Nickel Co., Inc., The ..... *

Jefferson Union Co. 126
Johns-Manville 49
Johnston Brothers, Inc. ..... *

Keasbey & Mattison Co..... *
Kellogg Co., The M. W. ..... *
Kennedy Valve Mfg. Co., The.. *

Leeds & Northrup Company.... *
Liberty Chemical Products Co... *
Link-Belt Co. ..... *
Liquid Conditioning Corp. ..... *
Lovejoy Flexible Coupling Co...131

Marley Company, Inc., The.... *
Maxim Silencer Company, The..129
McNeill Engrg. Co. ..... *
Metalock Repair Service, Inc....127
Midwest Piping & Supply Co., Inc. 41
Milton Roy Company ..... *
Monsanto Chemical Company.. 97

National Aluminate Corp. 34
National Boiler Protector Co.....127
National Valve & Mfg. Co. 108
Neff & Fry Co., The..... *
Niagara Blower Co. ..... *
Nicholson & Co., W. H. 126
Northern Equipment Co. 51

Oakite Products Co. ..... *

Peabody Engrg. Corp. ..... *
Pennsylvania Crusher Co. ..... *
Permutit Co., The .....Back Cover
Prat-Daniel Corp. ..... *
% Proportioneers Inc. % ..... *

Quaker Rubber Corp. ..... *

Reliance Gauge Column Co., The ..... *
Republic Flow Meters Co. ..... *
Richardson Scale Co. ..... *
Ric-Wil Co., The ..... *
Rockwell Mfg. Co. 38-39
Ross Heater & Mfg. Co., Inc....119
Roto Div. of Elliott Co. ..... *

Sarco Company, Inc. 6
Sier-Bath Gear & Pump Co., Inc.120
Simplex Valve & Meter Co. ..... *
Sinclair Refining Co. ..... *
Standard Oil Co. of California.. *
Standard Oil Co. (Indiana)....16-17
Sterne & Maley ..... *
Stets Company 126
Stone & Webster Engrg. Corp...104
Sun Oil Company 24-25
Syntron Company ..... *

Taylor & Co., W. A. ..... *
Taylor Forge & Pipe Wks. ..... *
Terry Steam Turbine Co., The..102
Texas Co., The 9
Thermix Corp., The ..... *
Tide Water Associated Oil Co..... *
Todd Shipyards Corporation (Combustion Equipment Div.) *
Treasury Department ..... *
Trimount Instrument Co. 122
Troy Engine & Machine Co. .... *
Tube Turns, Inc. 99
Tucker Sno-Cat Corporation.... *

United States Steel Corp. 109
Universal Atlas Cement Co. (Luminite Division) 109

Vogt Machine Co., Inc., Henry..111

Wallace & Tiernan Products, Inc. *
Warren Steam Pump Co., Inc...113
Western Precipitation Corp.....106
Wheeler Mfg. Co., C. H. ..... *
Whitlock Mfg. Co. ..... *
Wickes Boiler Co., The 31
Williams Gauge Co., The ..... *
Williams Valve Co., The D. T...131
Wilson, Inc., Thos. C. ..... *
Wing Mfg. Co., L. J. 95
Worthington Pump & Machinery Corp. 29, 115
Wright Chemical Corporation... *

Yarnall-Waring Co. *.....10-11, 52

Zonolite Company ..... *

Firms whose advertising is not in this issue but is appearing in other issues are marked with an *.

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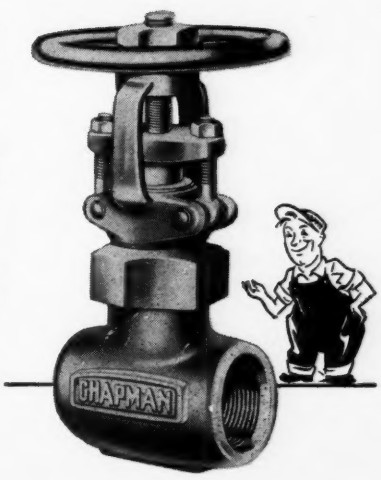

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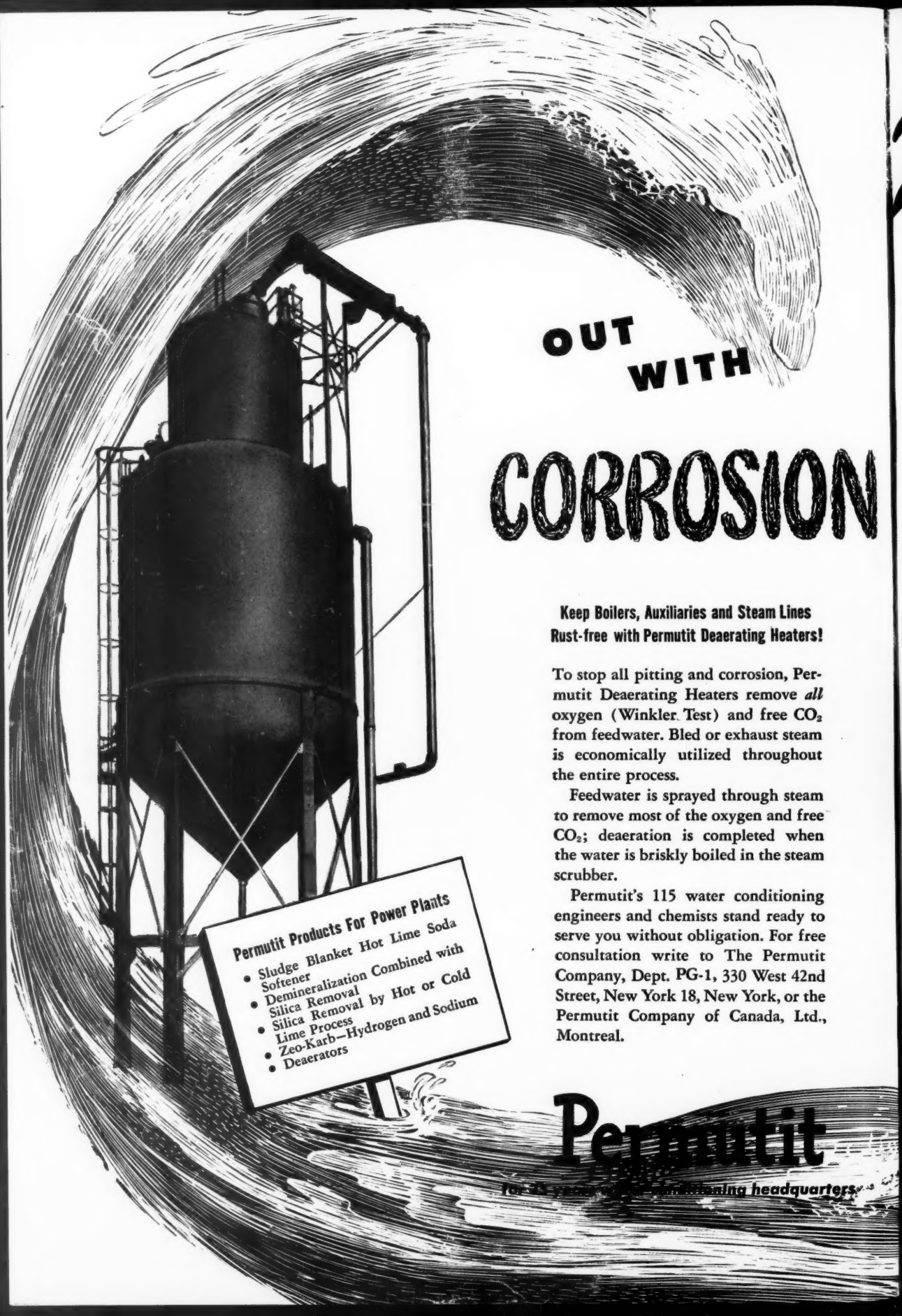
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